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VOLUME 3, No. 6 JUNE 1951

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WORLD CROPS

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VOL. 3 No. 6 JUNE 1951

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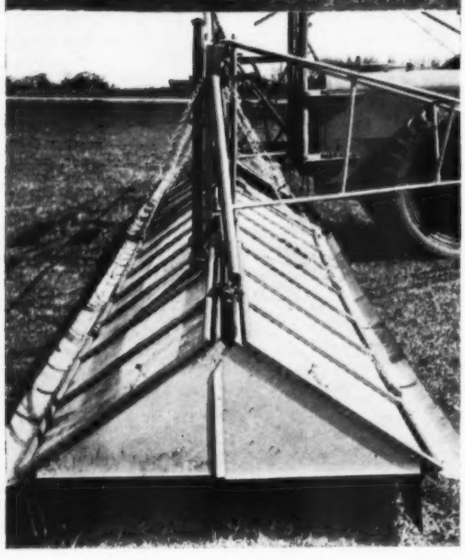

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Editorial Comment

A memorable week

THE week ended May 5, 1951, will surely go down to posterity as one of the more hectic in the history of this country since it marks the beginning of the series of displays known collectively as the Festival of Britain. Two events stand out: the first is the inauguration of the great South Bank Exhibition on the shores of the Thames, and the second is the opening of the thirtieth British Industries Fair, which on this occasion is designed to eclipse all previous efforts. An account of the agricultural aspects of both appears on other pages. They will be followed throughout the summer by numerous other local manifestations of an appropriate nature, while to the standing annual events such as the Royal Show and the numerous county and district shows there will be imparted a special festival flavour.

One may wonder indeed, whether in the present situation of the world in general and Great Britain in particular, there is anything specially conducive to festivity. Nevertheless, the centenary of the Great Exhibition of 1851 certainly is an event worthy of commemoration.

The intervening years have witnessed changes and developments never before paralleled in human history. They have seen the zenith, the nadir and the rebirth of British farming; still more striking has been the enormous proliferation of agriculture, largely under the guidance of English-speaking peoples, in previously undeveloped and largely unknown regions of the earth, notably the tropical countries, on which we now depend for so much of our food and raw materials.

They have also been marked by the astounding results that have followed and are still following the application of scientific research to the solution of agricultural problems. What a record of achievement in the way of improved crop varieties and fertilisers, ingenious mechanical devices, pest and disease control and what flood of light on the mysteries of the vital processes in both crops and soils!

One is impelled indeed to wonder what will be the position in 2051. Will that year bring with it the fruition of the dazzling possibilities of universal prosperity which all can see before them, as indeed the present year has seen the realisations of much, though by no means all, that our forebears envisioned a hundred years ago? Or will civilisation become engulfed in a destructive maelstrom of senseless strife engendered by too rapidly increasing populations and conflicting and too often ill-founded political ideologies? Only the future can show.

The sulphur shortage

THE shortage of sulphur supplies is one of the many major headaches in these troublesome times. The main difficulty is, of course, the effect it has on production of sulphuric acid, which plays a predominating part in so many manufacturing processes. Imports of sulphur from the U.S.A., whence most of the supplies are derived, have been cut by one-third and although strenuous efforts are being made to obtain increased allocations, the issue is still uncertain, while prices are rising steeply.

For the agriculturist the problem is especially disturbing in as much as the fertiliser industry is the largest single consumer of sulphuric acid in the United Kingdom; it now uses well over one-third of the supplies available to British industry; for superphosphate manufacture alone the annual consumption is about 470,000 tons, while a further considerable quantity is absorbed in the production of sulphate of ammonia. In addition, sulphur is extensively used for the control of plant pests and diseases; it has been estimated that about 2% of available supplies are used in this connection.

In the circumstances processes for making superphosphate and other fertilisers which will enable economies in the use of sulphuric acid are obviously of vital importance, and here the possible substitution of nitric for sulphuric acid holds out promise, since not only can nitric acid be prepared synthetically from the air, thereby lessening dependence on expendable mineral resources, but it may also lead to the preparation of improved fertilisers which contain two instead of one fertilising constituent, thereby diminishing bulk and enabling savings in transport and application costs.

The recent announcement by the British Department of Scientific and Industrial Research of a successful method of treating rock phosphate with a mixture of nitric and sulphuric acid to produce an acceptable substitute for superphosphate is therefore of considerable importance. The proportion of nitric to sulphuric acid employed in the process is roughly four to three, thereby enabling a major economy in the use of sulphuric acid. The method is successful because, during the process of manufacture, calcium sulphate is formed as well as calcium nitrate, the former coating the grains of the highly deliquescent calcium nitrate and protecting them from absorbing moisture from the air. The process gives a product which is relatively non-caking and keeps reasonably well in the British climate.

It is stated that experiments have also been carried out to produce a complete fertiliser by

adding potassium chloride, and a N-P-K fertiliser has been produced in experimental quantities which, although it is somewhat more sensitive to moisture, nevertheless gives promise of being a reasonably satisfactory product in practice.

These experimental results will need to be amplified by large-scale manufacturing trials and experiments in the field, but it may well be that if these are satisfactory, the present sulphur shortage will result in economies and improved efficiency in fertiliser manufacture.

Jute substitutes and mechanisation

ONE of the consequences of the continuing shortage of jute is the increasing attention which is being paid to possible substitutes in the Western Hemisphere. In particular Kenaf (*Hibiscus cannabinus L*) has been the subject of considerable large-scale trials in Cuba, the U.S.A., and elsewhere, some account of which appeared in WORLD CROPS last month.

Recently a bill has been introduced to the House of Representatives in the U.S.A., designed to provide a domestic supply of soft fibres, in which it is stated that not only have test plantings shown that kenaf can be grown easily and in large quantities in the sandy loam soils of the Gulf Coast, South Texas and California, but that *a mechanical process for removing the fibre from the stalk has been developed*. (The italics are ours.)

The latter part of this statement seems to be of considerable importance, for although the desire of the Western Powers to establish substitute jute industries is well known, it is also clear that high labour costs in the Western Hemisphere would preclude their economic production unless the problems of mechanised cultivation and mechanised extraction of the fibres could be satisfactorily solved. Cultivation problems have, it is true, already been largely overcome, including harvesting the stems, but until quite recently the mechanical extraction of the fibre had defeated those who had essayed to devise machines which would do the job satisfactorily.

Retting processes have, of course, been considerably improved and speeded up as the result of research, but it is at least doubtful whether they could ever be economically successful under Western conditions. At one time it was thought that the Krupp 'Stella' hennequen decorticator would solve the difficulty, but the percentage of wastage proved too high and too much stem was left adhering to the fibre.

Kenaf is, of course, synonymous with Bimlipatam jute and if machinery has now been devised which will decorticate it and bypass the need for retting, it may well revolutionise the production of other soft fibres such as roselle, the hemps and even jute itself.

Colonial development

THE recently published report and accounts of the Colonial Development Corporation for the year 1950 show that under the guidance of the new Chairman, Lord Reith, its operations have been subjected to a very thorough scrutiny and review.

The Corporation now has some 50 undertakings in operation spread over 22 territories, and of these 15 are classed as agricultural, 5 are concerned with animal products, 6 with fisheries, and 4 with forestry.

Development has been rapid, some might think almost too rapid; in any case, as we pointed out when discussing the report for the previous year, agriculture is such a chancy business it is impossible to expect that all schemes will be successful. A few of the projects, notably that of the much discussed Gambia Poultry Scheme, have been based upon inadequate local knowledge and over-sanguine expectations. On the other hand, it is reassuring to see that the majority are considered to hold out fair prospects for success notwithstanding that in some cases considerable reorganisation has been called for.

It is, moreover, heartening to read that experience has emphasised the necessity whenever possible, of experimental or pilot schemes as a prelude to large-scale development. We have repeatedly insisted on this point in these columns and indeed, so far as agricultural projects go, would like to go further and see it laid down that no agricultural scheme would be attempted without adequate preliminary experimentation, or at least not before all the essential data are available. The vast failure of the original East African groundnut scheme, which, of course, was not the responsibility of the Colonial Development Corporation, is a sufficient demonstration of this if one were needed.

The warning contained in the report, that the potential influence of the Corporation is apt to be exaggerated, is timely. In relation to the size of the territories and their populations, £100,000,000 is far too small a sum to obtain considerable improvement. The aim should be ultimately to attract outside capital and to stimulate further development by this means. The Corporation should be the pioneer which blazes the trail for further effort by private enterprise. It is there to take initial risks and to show by success or failure how far ideas for new ventures are well founded. It is, in fact, in itself largely an experimental organisation. Certainly its usefulness can be greatly increased by relating its own schemes to overall

regional plans; some of the schemes do, in fact, follow this pattern and the hope is expressed in the report that more will do so in due course. We can heartily agree.

Let us also hope that in the atmosphere of 'political freedom' now being so sedulously fostered and enthusiastically welcomed as the panacea for all past evils in the Colonial sphere the Corporation will find conditions favourable for its operations.

EPPO

IT is welcome news that the existing international organisation for the Control of the Colorado Beetle and the European Working Party on Infestation Control are to be merged into a larger organisation which takes within its scope the prevention of the spread of plant pests and diseases of all kinds in the European area. The convention to establish this was signed in Paris on April 18 by the representative of the United Kingdom. We understand that it has already been signed by the representatives of 13 European powers and that others are expected to adhere to it in the near future. The first meeting of the new body was held in Paris from April 18 to April 21; its title is the European Plant Protection Organisation, which, following current fashion, will doubtless become shortened officially to the form which we have used as the title for this note.

The Director-General is Dr. V. E. Wilkins, formerly Assistant Secretary in the English Ministry of Agriculture and well known for his work in this and allied fields.

The functions of the organisation are to advise member Governments on measures necessary to prevent the introduction and spread of pests and diseases of plants and plant products, to disseminate information about their outbreak and spread, to faciliate co-operation in research on phytopathological matters and to study possible ways of unifying and simplifying plant quarantine regulations. It will concentrate attention on pests and diseases of economic importance and in particular on Colorado Beetle, potato root eelworm, wart disease of potatoes, San Jose scale, pests of stored food and rodent pests of crops.

It is really a first step towards the world-wide co-ordination of efforts of this description, one of the aims laid down by FAO, which has welcomed the new body and will work in close association with it,

In the past much damage has been done by introduced pests and diseases in many parts of the world. The dangers are now widely appreciated and the majority of countries have legislation and administrative machinery to deal with the matter. These can, however, only be fully effective if they conform to an accepted general pattern and are applied with uniform and reasonably high efficiency. In this direction particularly the new organisation should prove of great value and do much to help prevent the spread of plant pests throughout European and Mediterranean territories.

International Crop Protection Congress

PARTICULARLY in view of the development described in the previous paragraph, a good deal of disappointment may be anticipated in a number of quarters that it has proved impracticable to hold the Third International Congress on Crop Protection this summer. The Second Congress, it will be remembered, was held in London in 1949 and proved an outstanding success. A summary of the proceedings appeared in the first number of WORLD CROPS. At its conclusion it was decided that the Third Congress would be held in Paris in 1951. Unfortunately, owing to a number of unforeseen difficulties it has not been possible to implement this decision and we understand the present intention is that the next Congress will take place in Paris next year.

Incidentally, an unofficial conference covering somewhat similar ground is being organised by Plant Protection, Ltd. in the latter part of June, which will be attended by a number of leading scientists from various parts of the world in the field of phytopathology. A short note describing the scope and objects of this meeting appears on another page.

It is the first occasion within our knowledge that a conference of this nature has been sponsored by a commercial firm and it seems a tribute to the esteem in which they are held that it has been possible to organise it.

FAO and rice in Asia

ON many occasions in these columns we have stressed that the expansion of rice production is the world's most insistent food problem and two technical meetings likely to prove of considerable importance to the rice-consuming peoples of Asia have been held at Bogor in Indonesia, between April 9 and 19, 1951. They were the second meeting of the working party of rice breeders and the first meeting of the working party on fertilisers in rice cultivation, both of which are units of the International Rice Commission of FAO.

Since its formation in 1949 as a result of the international rice meeting held under the auspices of FAO at Baguio in the Philippines in March 1948, the Commission, membership of which includes 17 nations, has proved a very active body.

The working party of rice breeders held its first meeting in Rangoon in 1950, one result of which was the co-operative project for rice hybridisation at the Rice Institute of Cuttack in India, designed to produce new varieties suited to particular environmental conditions. It is understood that at the Bogor meeting special attention was paid to the production of varieties resistant to the numerous pests and diseases which attack the crop, as part of a plan to bring together all branches of plant science in a concerted attack on rice production problems.

The meeting of the working party on fertilisers was held immediately after that of the rice breeders. As a preliminary, a member of the FAO staff had prepared a survey of information on fertiliser practice in 12 different countries in the East, summarising experimental results and evaluating methods for determining fertiliser needs.

The reports of these meetings will be awaited with interest and there seems every reason to hope that they will be productive of important results. There can be no question that continuous concerted and co-ordinated research and consultation over a wide field is a first essential for the rapid stepping up of rice production which is so urgently needed. And the work that FAO is doing in this connection is of the highest importance.

Standardising pyrethrum

A VIGOROUS effort by the Colonial Products Advisory Bureau to establish a world-wide standard for pyrethrum analysis has failed. This failure has not been due to lack of international co-operation—on the contrary, countries interested in pyrethrum whether as producers or consumers responded to the Bureau's lead in this matter readily and generously. The plain fact is that no method for pyrethrum analysis can produce accurate or consistent results. Not only are there disturbingly high variations between results when two different laboratories use the same method on the same sample, but the variations when different methods of pyrethrum determination are used are greater still. The special sub-committee of the Bureau responsible for this work sent samples of two different pyrethrum flower crops to more than 40 laboratories in Europe, America, Africa, Australasia, and Asia. Three standard methods of analysis were used in determining the pyrethrins contents of both samples. The collected results were then statistically examined. Every effort was made to standardise analytical conditions; minor variations in the particular methods were eliminated, reagent similarity was secured, and the possible variation through sampling errors was scrupulously avoided when the test samples were first prepared in a London factory.

Despite such attention to the controllable factors that might produce inconsistency, the figures given for the pyrethrins contents of the samples varied greatly. The Ripert method proved so inconsistent that it can be said to have ruled itself out; this is possibly the most positive conclusion of the investigations. The Seil and Mercury Reduction methods were in different ways equally variable and no recommendation to establish one of these two as the agreed international method could be made. All that could be suggested was that in any contract for pyrethrum the buyers and sellers should first agree which method should be employed in assessing the pyrethrin value of the material. The Mercury Reduction method consistently gives higher figures than the Seil method and disagreement is bound to occur if one method is used by the buyer and the other by the seller. Even when the same method is agreed upon, a variation of 0.3 in a total pyrethrins content of between 1% and 2% must be accepted as a variation due to the method and therefore insignificant as a measure of actual variation in pyrethrins content. Perhaps 0.3 does not sound a large amount —but 0.3 in a total of 1.5% is a 20% share of the real value of the material.

The major conclusion to be drawn is that we must not expect purely chemical methods of analysis to measure what are largely biological properties in natural and complex materials. It may well be sounder to try to establish bio-assay methods of pyrethrum evaluation. The Colonial Products Advisory Bureau deserve the fullest praise for their efforts, which have at least made it unmistakably clear that at present no method of analysis could be soundly appealed to in a disputed pyrethrum transaction. Their report (obtainable from the Bureau, Imperial Institute, South Kensington, London, S.W.7, 63 pp., 4s.) should be studied by all who are interested in the natural pyrethrum trade.

THIS MONTH'S COVER

The Persian Wheel—so familiar to dwellers and travellers in many parts of the East—the age-old device which for countless years the eastern peasant farmer has used to irrigate his crops. There are many forms, but that which is shown is the most widely used and the most familiar. The patient blindfold oxen move in a never ending circle, turning the wheel and actuating the water lift shown in the background, which raises water from some adjoining stream or pool, whence it flows in earth channels to the fields.

(Photo: Government of Pakistan Films Department)

Mechanical Cultivation of Rice in Malaya

E. J. H. BERWICK, B.Sc., A.I.C.T.A.
Malayan Department of Agriculture

This article, which discusses recent trials with large-scale mechanisation of rice cultivation in Malaya, is an extension of that on the Malayan rice industry, which appeared in WORLD CROPS *last month. An article on similar trials in British Guiana was published in our issue for October 1950. The possibility of mechanising rice growing in the wet tropics is of vital importance, and the two articles taken together enable an appraisement to be made of the difficulties and prospects.*

'THE trouble is that the Malays in particular, and, in only a slightly lesser degree, the other inhabitants of the Peninsula, are by choice rice eaters and only near starvation would make them alter their basic food.' This sentence from the Draft Development Plan of the Federation of Malaya, which has recently been published, together with the increase in population which has taken place in south-east Asia as a whole, provide the reason why the production of rice in Malaya must be increased. The average production from 1924 to 1930 was about 200,000 tons, grown on 650,000 acres, and this was about one-third of the amount of rice required by the country. In 1930, at the instigation of Sir Harold Tempany, then Director of Agriculture, a Rice Commission considered all aspects of the question; as a result a Drainage and Irrigation Department was started and research on breeding and agronomics was accelerated. These led to good results, but they were nullified to some extent by the Japanese occupation during which many records and most of the pure strains selected over a long period by the Department of Agriculture were lost and damage was done to irrigation works largely through lack of maintenance. By 1949, however, the area under wet padi had increased by 200,000 acres to 850,000 acres, which yielded some 380,000 tons of rice, almost twice that of the 1924-30 period. But during this time the population had increased and the country still produced only about one-third of her requirements.

Mechanised rice harvest by combine harvester drawn by an International T.D.6

The case for mechanisation

Malaya, with her rubber, tin, coconuts and oil palms, is, for a tropical country, rich, and on the whole, providing that supplies are available, she can afford to buy her rice. But the population of those countries which produce rice for export is also increasing, and the time may come when Malaya, even though she has the money, may not be able to buy the rice she requires. A policy of self-sufficiency would be ideal, but it is realised that this is likely to be impracticable. All possible methods to increase production are, however, being taken as an insurance, which, even if it does not cover all risks, will be valuable in times of emergency.

Most of the inhabitants of Malaya earn their living, directly or indirectly, from the export of tin, rubber or other cash crops, and there is not a large surplus of labour ready to march into new areas and grow more padi. Futhermore, it has been calculated that when padi is grown by hand, as all of it in Malaya is at present, the growers themselves consume over 40% of what they produce. If ever there was an urgent case for mechanisation, it would be for rice in Malaya and this explains the great importance which is attached, both by the Government and by the people in general, to the experiments now being conducted.

Trials with mechanical cultivation had been started in Malacca before the war but without much success. Advances made in tractor and implement design during the past decade, however, justified

a further investigation which started in early 1947. The first stage was to review the literature concerning the mechanical cultivation of rice in other countries in general and to investigate, in particular, any progress made in those countries whose problems were likely to be similar to those in Malaya. It was found that with the exception of the Mahaicony scheme in British Guiana no large-scale schemes had been started in the wet tropics; the nearest approach to what was required appeared to be the commercial production of wet padi in Louisiana and the Murrumbidgee area of New South Wales. In these territories, however, the rainfall during the cultivation season is consistently low, so that cultivation operations are performed virtually under dry land conditions. In Malaya, on the other hand, the average rainfall is considerably higher, its occurrence is erratic and large quantities may fall in a short space of time so that normal drainage is rarely capable of removing it within a reasonable period. It is thus not possible to be certain that the land will be dry at the time when cultivation must be carried out in order to obtain maximum yield and in most years it may be necessary to cultivate on wet or even flooded lands.

Existing conditions

The next stage was to make a survey of the conditions in which padi is grown in Malaya, based on the probable requirements associated with mechanisation in so far as they were known at that time. Most of the best padi in Malaya is grown on coastal clays, mainly in the north and east, and in these areas there is a rapidly growing shortage of new land. Areas such as these, it was considered, would be ideal for mechanisation but most of the new schemes, proposed by the Drainage and Irrigation Department, and on which they could provide the water control essential for mechanisation, are in inland swamps characterised by their deep peat soils. It was decided, therefore, that as most of the large areas likely to be available, without encroaching on land already alienated and planted under other crops, were on this peat, investigations into the mechanical cultivation of wet padi on peat soils must take priority over investigation on other soil types.

When the surveys had been completed the Standing Committee on Investigations, which includes senior members of both field and research branches and has power to co-opt other officers, discussed the matter and a comprehensive programme of investigations was considered. Funds to purchase required equipment were made available under a Colonial Development and Welfare Scheme and a central workshop and school for operators were opened at the Federal Experiment Station, Serdang, Selangor. Attempts to obtain the services of an adequately qualified engineer met with no success, but arrangements were made for a visit by a team of experts from the United Kingdom which finally materialised in June and July 1949, while an agricultural officer, trained at the National Institute of Agricultural Engineering, was recruited at the end of 1949 for work on the project.

Initial trials on peat soils

It was imperative that the investigations should proceed and so an area of 320 acres was selected at Chenderong Balai, in Stage IV of the Sungei Manik Irrigation Scheme in Perak. This site was chosen as on it the peat was up to nine feet deep and it was considered to be similar to much of the lands in the Trans-Perak Scheme, some 20 miles to the west, where the Drainage and Irrigation Department proposed to provide water on some 155,000 acres. Work in the field started in June 1947, with such staff and equipment as were available, and has continued since then.

Briefly, it appeared that the main obstacle to mechanisation on Malayan peats is the existence of hidden stumps and underground timbers in large numbers. This is inherent from their origin as they have been developed from jungle under swamp conditions. On parts of the experimental area these snags were removed so that mechanical cultivation could proceed, but it was soon found that not only did the peat shrink so that further snags came to the surface, but also that when the underground timbers were removed drainage control became difficult. On the credit side, however, it was found

School for operators at the Federal Experimental Station, Serdang

'Double-wheeled' tractor ploughing in wet padi land

A Ransome M.G. 5 small crawler ploughing padi land

Fordson Major tractor with modified wheels and drum roll

that standard crawler tractors, modified by an increase in track width to reduce their bearing pressure to something of the order of 2½ lb./sq. in. were capable of drawing the necessary implements. It was also shown that disc harrows could produce a satisfactory seed bed, on which standard type seed drills, again slightly modified, in this case by an alteration in the type of wheel, could be used. Furthermore, it was shown that at any rate on the shallower peats fair crops of rice could be grown.

Dr. E. W. Russell, of Oxford University, and Mr. J. C. Hawkins, of the National Institute of Agricultural Engineering, who formed the 'team' sent from the United Kingdom to advise on thse investigations, agreed that the main difficulties were the removal of the underground stumps and timber and the construction of adequate drains. Furthermore, they considered that even an investigation into methods of removing these timbers would be a costly business and that, if the preliminary investigations show promise of success, five to ten years of experimental and development work would probably be necessary before clearing could be undertaken on a large scale. It is clear that the funds and personnel at present at our disposal are insufficient for this and consequently work on peat soils has, at any rate for the time being, been suspended and all resources concentrated on investigations into the use of machines in padi production on clay soils.

Trials on coastal clays

It might be considered that there would be no object in introducing mechanisation into existing padi areas in which there is already sufficient labour. Nevertheless, it is possible that mechanisation might be able to perform certain operations which would increase yields and which could not be performed by hand or by animals; furthermore, it might be possible to accelerate certain cultivations by mechanical means so that an off-season crop of padi or other cash crop could be obtained which would provide money to pay for tractor and fuel. In a similar way, it might be desirable to mechanise certain phases of crop production at times when labour is temporarily inadequate, as, for example, at harvest. Trials were therefore started in settled areas on coastal clays, the investigations which were subsidiary to the main work at Chenderong Balai being carried out on Federal Padi Experiment Stations in Kelantan, Province Wellesley and Malacca.

It soon became clear that the problem was divided into two parts: firstly, the purely engineering side, how to get tractors and implements to work in wet padi conditions; and secondly, the agronomic side, what cultivations to do with them when they do work. In the 1947-48 and 1948-49 seasons the power unit was in most cases the Fordson Major, which is, comparatively, a heavy tractor for its power. The Ferguson and the International Harvester Farmall 'H' tractors are lighter although of less power and they have made the engineering problems considerably easier. To start with, standard wheels both steel and with pneumatic tyres were tested. With these satisfactory cultivations were performed in certain conditions and especially in Kelantan on the east coast where the clays are lighter. They were, however, useless for after-cultivations in flooded fields on the west coast. Attempts were then made to overcome the weight of the tractor by increasing the width of the wheels, and several types of drum and paddle wheels were constructed, but in general it was found that although cultivations could now be performed in the wet, rolling resistance had been increased to such an extent that little power was left over for useful work, maintenance costs were increased and the operation became uneconomic. Dr. Russell and Mr. Hawkins suggested that it would probably have been better if the diameter of the wheel had been increased rather than its width.

Crawler tractors

Trials were made with crawler tractors in 1947, but the types which the Department then possessed were unsuited for wet padi conditions. More recently, better results have been obtained with the International Harvester T.D.6, the Ransomes M.G.2 and the improved model the M.G.5. In general it may be said that the lighter crawler tractors show promise for the mechanical cultivation of wet padi provided maintenance costs do not prove to be too great.

Agronomic problems

On the agronomic side such treatments as early versus late ploughing, deep versus shallow ploughing and ploughing versus rotary cultivation, have been tried on both observation plots and replicated experiments. Although it has been found that it is possible to grow good crops of padi mechanically, using several of these treatments, the methods used so far do not result, on normal clay soils, in any greatly increased yield. With the exception of certain more drastic treatments, such as subsoil ploughing and chiselling, and tests to determine the minimum cultivation necessary to obtain a good crop so that non-productive periods can be reduced as far as possible, much of the work to be done in the future is not strictly mechanical. For example, it must be established whether two or even three crops of short-term rice produced each year will, over a period, give greater yields than that produced by a single long-term rice. In

what conditions will padi seed germinate best? What are the easiest and most effective methods of placement of manures? Is it possible to control weeds by hormone weed-killers either applied at the time of cultivation, or sprayed or dusted later; if, taking into consideration the vagaries of the weather in Malaya, the cultivation of off-season cash crops, such as groundnuts, soya beans, gingili (*Sesamum*) and possibly jute, is it likely to be an economic proposition over a period of years?

Mechanised harvesting

As far as harvesting is concerned, a good sample of padi has been produced in Province Wellesley with a combined harvester, but only on off-season padi in ideal conditions. A combine, however, is of necessity a heavy unit and, on first principles, the use of a header and the subsequent threshing of the padi on firm ground, would appear to be more sound. Attempts have therefore been made to design and produce a padi header, and the prototype recently tested in Kelantan showed promise. All in all it would appear that, if large areas are available and adequate drainage possible, there would be little difficulty in harvesting mechanically although some research to find the strain of padi which is most suitable will be necessary.

Conclusions

It has been found, therefore, that the prospects for mechanisation of the rice crop or for any other short-term crop on peats are not promising, but that on coastal clays some of the operations necessary to produce satisfactory crops can be mechanised, and that if large areas of land were available there would be little difficulty in producing fair quantities of rice. As has already been pointed out, most of the known coastal clays in Malaya are already planted with rice or other crops. A search has therefore been made for new areas of coastal clays and an area of some 7,000 acres has been found in Pahang Tua, near the mouth of the Pahang River on the east coast. Assuming that drainage and irrigation can be provided, consideration is now being given to a pilot scheme of about 200 acres here and it is hoped to plant some of it in the 1951-52 season. It is also encouraging to be able to record that recent soil surveys made in the northern areas of the Trans-Perak Scheme indicate that there are larger areas of coastal clay or at any rate of shallow peat than was previously thought, and so it may be possible, when the survey is completed and when irrigation water is available, to start a scheme to grow rice mechanically there, and so provide the insurance in food supplies which Malaya so badly needs.

Photos: Dept. of Agriculture, Federation of Malaya

Gold Coast Cutting Out Suspended

Reasons for the Gold Coast's new policy of suspending temporarily the cutting out of cocoa trees suffering from swollen shoot have been given in the Gold Coast Legislative Assembly by two of the newly appointed Ministers.

Their statement follows the announcement that the Executive Council has agreed that there should be total suspension of compulsory cutting out for one month, while an enquiry into the organisation and methods of the cutting-out campaign is held. Cutting out will continue on those farms whose owners agree to it.

Mr. Nkrumah, Leader of Government business in the Legislative Assembly, said: 'I emphasise that the question of cocoa is a very delicate one, and we must not play with something on which the future prosperity of our country depends. I want to make it quite clear that scientists have so far produced no effective treatment for swollen shoot other than cutting out. This Government must, therefore, accept cutting out as the only possible treatment unless science can produce a better one. What we were concerned about was the method and organisation of cutting out and it was in order to investigate this matter of method and organisation that the Government agreed to a temporary suspension of compulsory cutting out."

Locust Outbreak in Persia

AN outbreak of the desert locust of very serious dimensions is reported from Persia which, if it is not controlled, seriously threatens crops not only in that country but in many adjoining lands between India and East Africa. It will be remembered that a similar outbreak occurred in Arabia last year, and the present one seems to be a recurrence and extension of this threat. It was not entirely unforeseen, since at the International Locust Conference held at Karachi in 1949, experts envisaged its possibility. Exact data concerning the magnitude of the threat are not yet available, but from cabled information it would seem that the infested area may cover a total of about 130,000 square miles, while it is also reported that Persian locust experts have located an egg-bed covering 1,600 square miles, in which many locusts are starting to hatch, some being in the second and third nymphal stages. The territory threatened is said to be the fertile south-eastern part of Iran, bordering the Persian Gulf.

Combating the outbreak

To combat the outbreak, the Persian Government appealed for assistance both to the United Kingdom and the U.S.A. In the United Kingdom, in response to this request, Plant Protection Ltd., with the co-operation of the Anglo-Iranian Oil Co., despatched on April 19 by air, 30 tons of 'Agrocide' (a benzene hexachloride base) for locust bait, and this has now arrived at Abadan. Mr. O. B. Lean, a member of the staff of this company and a leading expert on locust questions, has gone to Persia in connection with the outbreak, accompanied by four other English entomologists.

In the U.S.A., a first shipment of 13 tons of 'Aldrin' was despatched by air on April 9 by the State Department for use both as sprays and baits, the material being supplied by Messrs. Julius Hyman & Co., the manufacturers. It was transported by two C-54 transports, which also carried six light planes equipped for applying insecticides.

'Aldrin' is among the latest of the chlorinated hydrocarbons to be used as insecticides; it was described in the issue of WORLD CROPS for April 1951. Its use against locusts is a new development, and progress will be watched with interest. We are informed that Dr. John Hardy, Director of Shell Chemical's Experimental Station at Woodstock, Kent, has proceeded to the scene of operations by air as an observer of operations in this connection.

We are further informed that an offer of assistance has also been made by the East African Desert Locust Commission.

It is obvious that very energetic action is being taken to render all possible assistance to the Persian authorities to enable them to deal effectively with the very serious threat with which they are confronted, and it is hoped that they will be crowned with success.

Some Problems of Greek Agriculture

Dr. C. de FELLNER

Greece has suffered severely from war and political disruptions in recent years. Its agriculture is still backward, but considerable efforts are being made to improve it. The following is an account of the present position; the author has recently returned from a visit to Greece.

Harvesting rice at Anthele on land which hitherto had never produced anything of value. ECA assistance enabled irrigation works to be carried out and the land now yields 82 bushels/acre

GREEK agriculture is of special interest in as much as it shows the pattern of agriculture in a country which was devastated by war and political upheavals, and which is now trying to rebuild its shattered economy with all the technical help, credit, implements and commodities which the U.S.A. can offer. It should accordingly provide an answer to the question, how far can scientific and practical aid help to remodel the agriculture of an old Mediterranean country with ancient traditions, confronted with great natural and economic difficulties ?

General background

A few general observations on soil and climatic conditions will help to throw some light on the main problems. Climatically, Greece can be divided into two zones—a southern zone, having a temperate Mediterranean climate, and a northern zone, which though more continental in character, still has an average temperature of about 68°F. The rainfall in both zones is restricted to late autumn, winter and early spring. Summer is normally dry, starting in May and ending late in September. In the north the dry period is shorter than in the south, owing to continental influences. In both zones an outstanding characteristic is the high amount of sunshine, averaging in the south from 2,600 to 3,100 and in the north from 2,400 to 2,600 hours per year.

There is a great variety of soils, a consequence of the rather rugged surface structure of the country and the reaction of sun and torrential rains on the limestone rocks, from which the predominant ' terra rossa ' or ' rendzina ' soils of the south originate. In the north the soils are mainly steppe-like of the chernozem type, with low lime and high clay contents, though terra rossa is also found in the north, as a result of the weathering of limestone rocks; such soils often show characteristic white patches, while forest and chestnut forest types also occur. As a rule, the agricultural soils are fertile, although some very poor leached soils with low humus contents also occur.

Agricultural conditions

Greece is typically a country of small holdings. The standard measure of area is the ' strema,' approximately a quarter of an acre—and this in itself indicates the small size of the average holding. Except in a few fertile valleys and estuarine localities, the holdings are interspersed between barren rocky areas. The fact, therefore, that only a small part of the country, indeed not more than 22.2%, is under cultivation, should not cause surprise, as a considerable part of Greece consists of rocky and waste mountain land that yields only scanty pasturage for sheep and goats, and is of little productive value.

As the available area per inhabitant is rather small—about the same figure as in pre-war Britain and Germany—the need is for intensive systems of agriculture which will produce the highest possible yields to meet the requirements of an expanding population. Water is a prime limiting factor, and maximum yields can be realised only where irrigation is possible or where special products such as wine, grapes or fruit can be grown.

Cereal production

The most important products of Greek agriculture are cereal crops, namely, wheat, rye, barley, oats, maize and rice. The chief cereal grown is wheat, the annual area cultivated under this crop being, approximately, 2,200,000 acres out of a total area cultivated in all crops of 5,000,000 acres. The total yield of wheat in normal years is approximately 900,000 tons and the average yield per acre is therefore 14.8 bushels. Oats are grown on 350,000 acres, barley on 500,000 acres and maize on 600,000 acres. These figures illustrate the predominant importance of cereals in the Greek agricultural economy. The tendency is towards continuous cereal production and crop rotations are only in evidence to a minor degree. The total area of leguminous or forage crops which might be grown in rotation with cereals is very small, and it is perhaps fortunate that cotton is showing signs of proving to be a possible alternative crop for inclusion in a rotation.

As a result of this, fertility on the whole is tending to decline somewhat. Moreover, the absence of leguminous plants and pasturage which together do not cover more than 11% of the total cultivated area in the country, means that there is little development of animal husbandry.

It is noteworthy that of late years rice production has extended quite consider-

ably and, like most of the areas that are under irrigation, the technique of cultivation and the yields are on the whole decidedly satisfactory. The acreage under rice has increased from 5,000 pre-war to 25,000 at the preseat time with an estimated yield of 32,000 tons of padi, while further expansion is possible.

Cotton

In the pre-war period cotton cultivation covered between 120,000-130,000 acres. Since the war the acreage has extended to nearly 200,000, giving a total yield of some 63,000 tons of lint. The varieties of cotton grown are mainly the middle staple Turkish varieties.

Viticulture and wine

After cereals, wine is one of the most important products of Greek agriculture. The area under wine grapes is roughly 400,000 acres, and very little change has occurred in this for many years. Before the war the yield of grapes totalled about 350,000 tons annually, but as a result of improved management, intensive spraying and the replacement of old vines, it has increased to 450,000 tons in the last two years.

Home consumption of Greek wines accounts for the bulk of the crop, but owing to the increased yields there is a growing surplus available for export; unfortunately, other countries are not yet very appreciative of Greek wines and there is some difficulty in disposing of export surpluses.

Table grapes are grown on about 25,000 acres and the produce is partly consumed locally, but there is an appreciable export trade. The acreage under 'currant' grapes, for centuries a traditional product of Greece—especially in the Corinth Peninsula from which the name is derived —has been reduced somewhat of recent years owing to unfavourable marketing conditions, but it still covers some 120,000 acres and yields 70,000-90,000 tons a year.

Olives

Olives have for centuries been an important item in Greek agricultural economy. It is estimated that there are 65,000,000 olive trees in production. The following table shows the production both of olives and olive oil for the last four years:

	Olives (tons)	*Olive Oil (tons)*
1947 ..	56,000	145,000
1948 ..	18,000	46,000
1949 ..	93,000	218,000
1950 ..	27,000	54,000

Fruit and vegetables

Fruits and vegetables are also important products. The cultivation of tomatoes is a flourishing industry; about 47,000 acres are under cultivation, yielding approximately 300,000 tons of fruit. Much of the crop is canned and the canning industry, which is equipped with up-to-date machinery, is prospering, although difficulties are being experienced in marketing exports owing to high production costs. In consequence there is a tendency to stop further expansion and efforts are being made to switch over to other vegetables such as peas, bush beans and ochras.

There is a considerable production of melons, which are grown on about 80,000 acres, mostly for home consumption, while about 40,000 tons of figs, both fresh and dried, are produced annually. If production costs could be lowered an export trade could probably be developed, in which event the further expansion of fruit and vegetable production might be expected to occur.

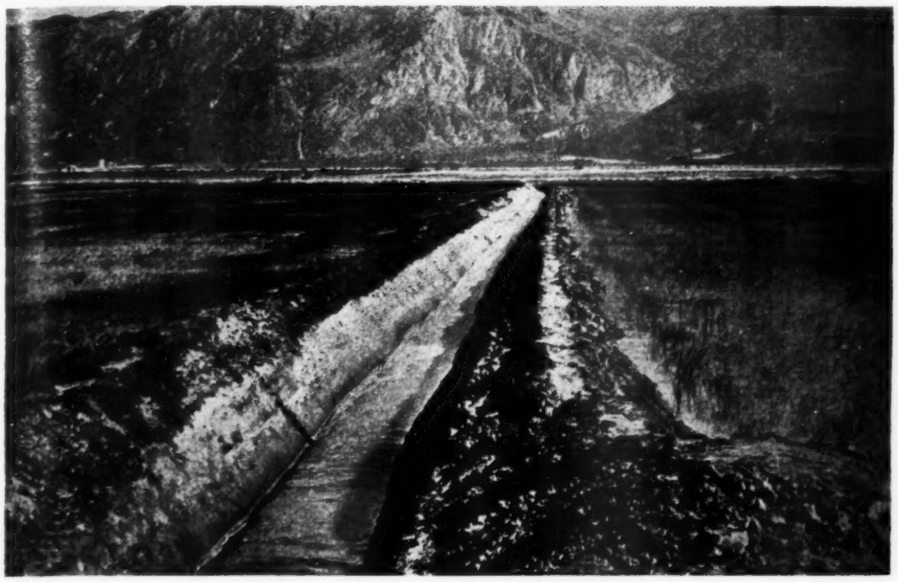
Tobacco

Tobacco has in the past been an important item in Greek agriculture. It is still grown on about 250,000 acres, yielding from 45,000 to 55,000 tons of cured tobacco annually. In pre-war times little difficulty was experienced in disposing of the surpluses available for export and a considerable market for Greek tobacco existed in Germany. Since the war, however, Germany has been flooded with American cigarettes and the demand for high quality oriental tobacco has declined. It may be that as the exportable quantity of Greek tobacco is small, the difficulties could be got over by blending Greek tobacco with Virginia types, but the main trouble again is that, at present, Greek tobacco is very expensive—probably the most expensive of all oriental tobaccos—while the possibility is further complicated by existing economic and political conditions. It would seem that it would be advantageous if tobacco production could be decreased and alternative crops found.

Discussion

Continued large-scale cereal production is an economic necessity, since upon it depends the maintenance of the food of the population. On the other hand, under existing conditions it is causing a steady drain on soil fertility. Moreover, the difficulty cannot be entirely surmounted by the use of artificial fertilisers, since the hot and dry climate precludes fertilisers from exercising their full effects. It is probable that if more farmyard manure could be made available the position would be improved, but this is difficult as animal husbandry is only practised on a small scale and is inefficient mainly by reason of the extremely low standard of forage production. A further adverse factor is the very unsatisfactory tillage practised at

Restoration of the Greek road system is gradually being carried out and it is estimated that by the end of 1952 4,470 miles of highways will have been restored. Photo shows a road in the Peloponnese



Anthele rice lands. Irrigation on these extensive tracts of salt and alkali flats renders the land clear and ready for cultivation after lying barren for centuries

present, mainly due to the lack of good working animals and the scarcity of cultural equipment.

The whole constitutes a vicious circle that is steadily diminishing potential production, and it seems essential that it should be broken if Greek agriculture is to be made more productive. Nearly every branch of Greek agriculture requires some improvement, but the basic need is better tillage. As a result of the pioneering work of the ECA Food and Agriculture Mission and its Field Extension Service, tractors and implements are being introduced and improved methods of cultivation and soil conservation inaugurated, but much still remains to be done.

The overall picture

The predominating factor is, of course, the widespread destruction caused by war and revolution. It is true that reconstruction was commenced in 1946, but it is still very far from complete; the greater part of Northern Greece was only freed from rebel activity in 1949; after the restoration of peaceful conditions the majority of the repatriated peasants have found shelter in houses built in 1950 when the major part of the emergency village housing programme was completed, in the course of which 56,000 houses were built. As a result the widespread ruins of the farms and homes are slowly disappearing, and the foundations of agricultural recovery are being laid. Manifold technical questions, however, remain to be tackled and this requires the wholehearted co-operation of the General Administration and the Agricultural Authorities, with the assistance of foreign advisors and materials; but this cannot succeed without efficient work and willingness to accept new ideas on the part of the farmers themselves. The Greek peasant farmer is naturally a hard worker. He is like all farmers, attached to traditions and is reluctant to abandon his established practices until he has been induced by efficient demonstration and persuasion to appreciate the value of modern agricultural methods. In this task general and adult education, books, leaflets, films and radio propaganda can play an important part, but the best inducement of all is practical example. If, for instance, a few peasants in a village can be persuaded to adopt a new system and this proves successful, the remainder of the agricultural population will follow suit in due course. It is encouraging to record that the ECA Mission has a number of efficient field advisors on their staff who are pursuing these aims with great perseverance in face of difficulties arising from natural conditions, lack of materials, and too often incompetent administration.

Economic factors

Despite local production, Greece has still to rely on imports, not only for many industrial products but also for a considerable part of her food requirements. Production costs and prices, both for locally produced and imported materials are very high, while high rates of interest preclude the farmer from obtaining the capital necessary for intensified production which alone can lower costs. It would be an advantage if, for example, larger quantities of coarse grain could be imported, since this would enable the excessive acreage of cereals to be reduced and the area under leguminous crops increased, thereby improving the soil and providing additional supplies of protein foods for home consumption. The production of vegetables for canning and certain fibre crops could also with advantage be extended. Such developments necessitate a flexible and imaginative agricultural price policy which would have to be associated with efficient management of currency difficulties. In any event, it seems essential that both Government and farmers should become increasingly export-conscious. A source of difficulty is the somewhat inefficient and underpaid Greek bureaucracy, many members of which live in constant uncertainty as to whether, under the prevailing system, a political change will deprive them of their livelihood. It is, on the other hand, satisfactory to record that the staffs of the numerous research stations, although they are little better off economically than the general range of civil servants, are much more efficient and the work of the stations themselves is remarkably good. The substantial help that the stations have received from ECA funds has exercised an important influence and has already greatly assisted the recovery of Greek agriculture.

Some requirements

The first need is improved soil conservation and tillage, and following this the establishment of an efficient system of crop rotation. Increased cultivation of leguminous crops seems to be the most direct and effective way of enhancing fertility, and here there is need for the improvement of varieties cultivated; in this connection the crop research stations at Larissa and Saloniki are doing excellent work and have already produced some promising new strains. Unfortunately, the publicity given to their work is restricted and requires to be greatly extended.

New types of forage crop are also badly wanted. Moreover, the extension of the cultivation of fibre crops such as hemp and flax would probably give satisfactory results and from them new manufacturing industries might be developed.

It is fortunate and perhaps curious that there are still not unimportant reserves of land which could be brought under cultivation, notably about 250,000-300,000 acres of land on some of the river estuaries at present mainly occupied by liquorice shrubs and scrub vegetation of little value;

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NEW BOOKS

Locust Research and Control, 1929-50

By Dr. B. P. UVAROV, C.M.G. Pp. 67. H.M.S.O., 1951, 5s.

Some 20 years ago the United Kingdom Government initiated a scheme of anti-locust investigations which received the ready support of a number of foreign Governments, and the results formed the subject of numerous official reports and scientific publications. Dr. Uvarov's report, however, presents the first connected story of the development, organisation and results of these investigations, as well as suggesting future anti-locust policy.

In the early stages investigations were centralised in a special section of the Commonwealth Institute of Entomology, but their organisation was subsequently taken over by the Colonial Office, and the Anti-Locust Research Centre established under the direction of Dr. Uvarov.

While progress in locust control and research between the years 1929-50 exceeded expectations, the report stresses the danger of assuming that the problem in Africa has been largely solved. No such assumption would be justified, and no relaxation of the present international efforts to contain locusts within their limited outbreak areas will be possible until the means for permanent prevention of plagues are found.

The report considers that the introduction of modern insecticides and machinery into locust control demands profound changes in the organisation of campaigns. In some countries the responsibility for control still rests with the owners or users of the land.

'The archaic anti-locust laws, which have had their use in the past, now constitute an impediment to effective locust control and should be revised to suit modern conditions,' says Dr. Uvarov.

Today's most difficult problem is provided by the 'Desert' locust, which is at present swarming over a vast area, from India to West Africa, where a large-scale campaign is being waged.

Fruit-Grower Year Book—1951

Pp. 236. Benn Brothers, 1951, 10s. 6d.

This book has been designed principally for the fruit grower, also for flower and vegetable growers, and will no doubt prove itself extremely useful to the grower who buys it, whether he be amateur or professional. In its 150 pages there is a wealth of information on subjects ranging from fruit pollination tables to marketing facts and figures, names of distributors in the U.K., plant equipment guide, organic and inorganic manures and many other subjects to which the fruit grower is constantly referring. All the commercially grown fruits are listed with notes on their origin, description and commercial season. Eighty-five pages of advertisements serve as a buyers' guide in themselves, covering a wide range of commodities commonly required by the grower.

Maize in the Great Herbals

By J. J. FINAN. Pp. xiv and 43. Illustrated. Chronica Botanica, 1950, 21s.

The origin and history of maize, so intricately associated with the history of man in the Americas from the earliest times, are gradually being elucidated as the result of four lines of research: botanical, genetical, archaeological, and historical. Mr. Finan turns westward, to the comparatively recent story of the spread of maize to Europe. By his careful assessment of the information to be culled from the Spanish chronicles of exploration of the New World and from the European herbals of the 16th and 17th centuries he has done much to unravel this part of the baffling history of maize. He reveals that two general types of maize are described in the herbals. One of these is similar to the flint maize of eastern North America; it was believed to have been brought into Europe from Asia: where such a type actually came from is still a matter of fascinating conjecture. The second type closely resembles the present-day maize of the Caribbean area and was very probably introduced into Europe by the early Spanish explorers. Much of the delight of reading this scholarly piece of work lies in the reproductions of the old woodcuts of the maize plant, and in the extracts from the texts of the herbals, with their entertaining amalgam of quaint credulity and keen observation.

THERESA ASHTON

Complete Spraying Programme

For Fruit Growers, Hop Growers and Market Gardeners. Illustrated. Pp. 87. 1951. Obtainable from the Murphy Chemical Company, Wheathampstead, Herts.

The 1951 Murphy Spraying Guide has been revised and brought up to date since the last booklet was issued, and among the products described, of which there are nearly 100, are 13 new materials, including toxaphene and new plant-activating materials (see WORLD CROPS, March 1951, p. 94). Experiments with hormones have shown that they may increase cropping and/or larger fruit on Bramley and Cox apples, and may give increased or earlier cropping on potatoes and peas and improved cropping of cereals, lettuces and mushrooms. There is also evidence that one of the hormones may confer on fruit trees a certain degree of frost resistance. Limited quantities will be available for this season under a special scheme. Growers who are interested and would like to try these materials for themselves are invited to write for further details to the company.

The second half of this booklet tells the grower when to use sprays and gives alternative spraying programmes for different conditions, *e.g.* for apples, whether red spider is important or not. These programmes are clearly and thoroughly described.

Ialine 2,4-D

We have received a copy of a booklet with the above title, dealing with this preparation, which is a new formulation of the well-known weed-killer 2,4-D. In this case the product is the amine salt which the manufacturers state combines in effective form the three qualities of efficiency, economy and safety in use with either high or low volume sprayers.

The booklet describes the characteristics of the preparation, the precautions that must be observed in using it and the manner in and the crops for which it can be suitably employed. It is obtainable from Messrs. Burt Boulton and Haywood, Ltd., Crabtree Manorway, Belvedere, Kent.

Greek Agriculture—*continued*

they have fairly rich soils and their irrigation is possible. The task of developing these lands, primarily a question of mechanical cultivation and development of irrigation, is actually being tackled by the ECA Mission.

Conclusion

The main aspects of the various problems have been described in the preceding paragraphs. The difficulties and problems are many, but there does seem to be some hope that if war or fresh political upheavals do not again disrupt the agricultural economy of Greece, there may be prospects that the present policy will succeed in improving production and that in the future the prosperity of agriculture will be greatly enhanced.

Photos: Greek Information Office.

The Development of Soil Conservation in Kenya Colony

Part I The Earlier Years

COLIN MAHER, M.A. (Cantab.), Dip. Agric. (Cantab.), A.I.C.T.A.

Senior Soil Conservation Officer, Department of Agriculture, Kenya Colony

Soil erosion is almost certainly the major agricultural problem of large parts of East Africa. In this, the first of two articles, Mr. Colin Maher traces the development of the menace in that territory and the manner in which conservation practices have been evolved.

(*Top*) **Gulley erosion after heavy rain caused soil from this land to choke newly-made terraces on an adjacent farm**

(*Below*) **Sheet and gulley erosion on old maize field farmed by European. Note breaks in inadequately built terraces**

EVEN primitive peoples eventually learn by experience that if top soil is lost, harvests will be poor or may fail. They see, too, that eroded soil piles up against fallen tree trunks lying across the slope. An obvious step, therefore, is to place obstructions where muddy water runs off the land after heavy storms, so as to check its velocity and cause it to drop silt behind them.

Early efforts

It was common to see in the Kenya native reserves, even many years ago, small logs placed across cultivated slopes in order to save some of the precious top soil. Less commonly, lines of stones were laid across the slope There are signs in one or two places of more ambitious rough contour walling with larger stones. Probably this work was done two or three centuries ago by peoples who emigrated or were destroyed under the pressure of Hamitic or Bantu invaders; nowhere is there evidence, however, of anti-erosion works of the complexity of the rice terraces in the Philippines, nor comparable with the retaining walls, up to 50 ft. high, built by the Incas of Peru.

In certain densely populated islands in Victoria Nyanza, such as Ukara and the Sese islands, the threat of starvation induced the population to stem the removal

of soil by making use of rubbish, sticks and stones, to reduce the velocity of the run-off. It is probable that under the shifting cultivation system formerly usual in East Africa, erosion became acute as the organic matter of the soil disappeared from two to five years after clearing the bush. Where the population was not dense and circumstances permitted, a fresh piece of bush was cleared and burnt as soon as the danger signals were seen. Only if peril from enemies or from wild animals rendered a group loth to move from their villages or their forest clearings, or if suitable land was not obtainable elsewhere, was some serious effort made to retain the top soil of their fields.

In higher districts of the Kikuyu Reserve, for example, Upper Meru and Embu, where the soil is rich and generally deep, I found in 1937-38 little attempt to prevent erosion. At lower altitudes, on the other hand, where it is hotter and the rainfall is uncertain, while the soils are poor and sandy, the people of Tharaka on the Meru Reserve and the Mbere of Lower Embu found it necessary to use lines of dead stalks of maize, sorghums and millets and rows of stones to retard the flow of run-off water and loss of soil.

Some further examples

Generally a richer soil, a high rainfall, or both, renders the neglect of measures for soil and water conservation less severe and less immediately evident in effect. Thus, in 1938, natives of South Tiriki in Nyanza Province, near Kisumu, were continuing to follow their traditional custom of piling loose rocks and stones into heaps, rather than placing them in contour rows or walls, to check the movement of soil, even on steep hillsides on which soil loss through erosion was plain. Another custom followed by some tribes was the planting of rows of bushes or of grass across the slopes to check soil movement. Amongst the plants used were *Coleus* spp. (*C. barbatus* and *C. umbrosus*), also used to fence enclosures near the family villages. Probably use was made in some areas of local strains of Elephant or Napier grass (*Pennisetum purpureum*). However, the resistance shown later by tribesmen in some districts to the use of this grass for planting in contour rows indicates, perhaps, that the practice was not traditional.

In the Kiambu Reserve of the Wakikuyu, near Nairobi, certain coarse grasses, such as *Hyparrhenia* spp. and *Sporobolus* spp., were used to mark boundaries of cultivation plots. Whether by accident or design, these were sometimes planted in horizontal lines which had some effect in checking soil loss.

In Kitui, one of the Ukamba Reserves, in 1937, I saw cereal straw mulched over the surface generally which, of course, was of great value in preventing soil wash.

More general aspects

The foregoing describes measures taken spontaneously by Africans to check erosion. In most areas, however, the bush rotation, or shifting cultivation, was of prime importance in preventing loss of soil from reaching disastrous proportions. The natural succession of plants on abandoned fields generally included some legumes and deep-rooting bushes and trees, which brought to the surface nutrients from depths below those to which the roots of crops ordinarily penetrate. The restoration of the protective canopy of savannah trees was quicker owing to the custom of lopping the larger trees rather than felling or stumping them.

Mixed cropping was also important in many areas in preserving and improving the soil. In between the stalks of the cereal crops and pigeon peas (*Cajanus cajan*) trailed broad-leafed cucurbitous plants—gourds and pumpkins—and legumes such as ' Njahi ' (*Dolichos lab lab*) and *Phaseolus* spp. which partially protected the soil from the heat of the sun—reducing the rate of destruction of the soil-binding organic matter—and from ' splash erosion ' caused by beating rain drops.

This was the position up to the early 'thirties. There was insufficient European supervisory staff to secure much advance in the extension of soil conservation measures and, indeed, there was some uncertainty as to the methods which should be undertaken. Meanwhile, the African continued to carry out these simple palliative measures (or to neglect them). As a cash economy grew and as relative freedom from major pestilences and famine speeded up the rate of population increase, the fallow periods were shortened and the greater demands on the soil caused erosion to increase and the application of remedial measures to become more urgent.

The European areas

Meanwhile, parallel events were occurring in the European areas. Large areas had been ploughed up for growing maize and wheat in the 'twenties, and these, devoid as they were of any system of protection against erosion, were showing very serious soil losses by the beginning of the third decade. In the Rift Valley great fans of volcanic ash soil washed down the slopes, blocking farm roads and streaking the hillsides with incipient water courses. Some farmers tried to dam the muddy floods by means of low wattle fences, but the floods went round or over them. Many maize fields on sandy soil in the north-east part of the Trans Nzoia suffered an amount of erosion and deterioration from which some of them had not recovered 20 years later. Some farmers in this district read of hillside ditches constructed on the contour for controlling erosion in Southern Rhodesia and many tried this method; but slopes too steep for cultivation had been ploughed and the ditches were too widely spaced. The torrential rains and impressive erosion finally defeated the farmers' attempts at clearing the eroded silt and sand from the ditches. Eventually the fields, in a time of depressed maize prices, were abandoned to natural pasture. Eroded soil held by the ditches had built up ' benches,' or raised terraces, 5 or 6 ft. high, and water pouring down over these left eroded scars which took 20 years to cover over with grass.

By 1932, however, the Barnes Brothers at Hoeys Bridge and Wolryche Whitmore at Rongai had started to protect their fields by forms of broad base terrace banks, after the form of the American Mangum terrace (absorption type) and the Nichols terrace (drainage type). This work in the European areas was to have a considerable influence several years later on soil conservation in the native reserves.

Other European farmers planted long bands of Elephant grass across their fields, usually with scant attention to contour, to check the run-off and reduce the losses of soil which had been increasingly evident for several years.

The position in the 1930's

In the early 'thirties East Africa was affected by the world-wide slump and depressed prices for crops; there was pressure from the Governments for increased production of cash crops in the native areas, a motivating factor for this being the difficulty experienced in collecting taxes. The number of agricultural officers in the reserves, which was very small, was increased. A large part of their time, in Kenya at any rate, was, however, taken up with the organisation of marketing and the increased cultivation of cash crops; this, however, only accelerated a natural tendency which derived from the effect on the Africans of contact with a Western cash economy.

The larger area under cultivation and the consequent contraction of the grazing lands and the area under fallow accelerated deterioration of the native lands, due both to overstocking by cattle, sheep and goats and to ' wash ' on lands on which were

Excellent ground cover resulting from mixed cropping, Kitui Reserve

Piece of land prepared for cultivation in the Kamasia Reserve, showing lopped trees

Trash lines on field with 9% slope, Mbere district. Note continuance of sheet and minor gulley erosion

Stones laid in rough contour rows, Mbere district, Embu Reserve

grown crops particularly liable to erosion such as maize and cotton.

Growing alarm

By the middle 'thirties alarm was beginning to be felt regarding the destruction of the soil in the African reserves in Kenya, Uganda and Tanganyika. Attention had already been drawn to the danger in Kenya by European settlers, visiting scientists and officials of Government, and in 1935 memoranda were exchanged between the Director of Agriculture and the Chief Secretary, Nairobi, concerning this menace to the future of the country. In 1937 the writer was seconded to examine and report upon conditions in the native reserves, and at the end of that year was given charge of a special section of the Department of Agriculture, the Soil Conservation Service, formed to give advice on soil conservation methods and to carry out work for the preservation of the soil.

Early protective methods

By the middle of the decade it was apparent that increased crop production in the native areas would have disastrous results if efforts were not made to protect and improve the soil. Blocks of overgrazed eroding grazing land were accordingly closed to grazing to enable the vegetation to recover. There was uncertainty, however, as to the methods which should be adopted to prevent loss of soil from the arable fields. There were few Europeans to supervise work, African instructors generally had poor education and no special training to fit them for this new task, and very few suitable instruments were available for setting out contour lines. It was natural, therefore, that the first attempts followed native practices such as the laying of bundles of trash across the slopes, and the planting of lines of grass.

The use of trash

The use of trash has indeed continued up to the present time. Where soils are still absorbent and the rainfall not too high, it has given good results; thus in the Embu district Africans today are still instructed to place trash above terraces to filter out much of the stilt from the run-off water before it enters the terrace channels. There are, however, objections to the procedure; thus if the soil is hard and non-absorbent the run-off from a heavy storm sweeps the trash before it. Moreover, trash lines of course make no provision for the removal of surplus water and this may burst over in many places, causing gullies to form. Even if this does not happen, much of the top soil may be deposited wastefully in a series of flat terraces or 'benches' which will complicate future work on the field, especially if animals and machinery are to be used for cultivation. This contingency is the more probable if the contour trash lines are too far apart—or at too great a 'vertical interval.'

Although this was in effect the resuscitation of an old African practice, considerable opposition was made by the natives to its re-introduction. Much maize trash was burnt in defiance of official edicts; Embu women marched to Nairobi as a protest against this measure, and all sorts of objections, chiefly futile, were raised.

Moreover, if the trash lines are not set quite accurately on the contour they concentrate wash at low points and cause gullies to be formed.

Grass lines

The setting out of grass lines was also begun and for this instructors of the Agriculture Department pegged guide lines for cultivators by means of 'line levels'—a mason's small spirit level suspended from the centre of a 25-ft. string held between two sticks of equal height.

Lines of clumpy grass of the type of *Sporobolus* spp. generally were found ineffective as they offered little obstruction to run-off, nor did they provide for the lateral removal of the accumulating and destructive water. Only partial success could be achieved even if clumps killed by cultivation, drought or browsing stock were replanted immediately and if the grass were cut periodically and the material laid to strengthen the barrier. This needs constant attention which African cultivators are rarely ready to give; and one of the few examples of a successful use of Elephant grass (*Pennisetum purpureum*) in Kenya was on the Agricultural Department Seed Farm at Fort Hall. Here the work was supervised for years by successive agricultural officers while the downward movement of soil to produce flat benches (not desirable on slopes under 8 or 10% or more) was accelerated by throwing the soil downhill by an ox plough.

The roots of Elephant grass, if the grass is not cut frequently, have a deleterious effect on crops for 6 or 8 ft. on either side—an important matter in a small African garden. At this time few Africans could be induced to cut this grass for stock feed or to provide material for compost; and only constant reminders could induce them to cut the grass to mulch the contour lines.

Generally a vertical interval of three or four ft. between contour lines is sufficient. A greater interval causes the top soil held by each barrier to be covered by subsoil stripped by the run-off from up the hill and leads to sterilisation by exposure of the subsoil or by burial of the top soil. If the contours are at vertical intervals as far apart as 8 to 12 ft., as is not uncommon, large volumes of water break down the slope at intervals causing gullies.

On the steeper hill slopes, however, the formation of bench terraces by retaining the soil behind hedges or contour barriers of grass is one of the few practicable and cheap methods of keeping the land in use. Much good was done on the Teita Hills near Voi in the Coast Province by planting contour lines of *Coleus* cuttings. The stems of this bush tend to be brittle, however, and to collapse under the weight of retained earth, particularly if the bushes are not kept well trimmed or if the vertical intervals are too great between the contour hedges.

Bench terraces need not only constant attention but the development of drains below each bank or 'riser' in order to remove surplus water. If this is not done, huge landslides of thousands of tons of water-soaked earth may occur from time to time. Such movements of earth on the grand scale have actually occurred in the mandated territory of Ruanda Urundi, in the Kigezi district of Uganda, and on the slopes of Mount Elgon in Uganda.

Contour walls

The obvious method of preventing soil movement on rocky slopes is by making contour walls from the large stones and boulders which abound, and attempts were made by agricultural officers to persuade local cultivators to build them. Africans accustomed for generations to the relatively easy shifting cultivation, where fire does much of the work, do not, however, take kindly to the heavy labour and co-operative effort involved in building permanent stone walls and only limited success followed.

Mechanised terracing in the Machakos reserve

In 1938 a free grant of £34,000 was made from the Colonial Development Fund 'for the comprehensive treatment against soil erosion of an area of 100,000 acres in the Machakos Reserve', where erosion was becoming widespread. The Soil Conservation Service began terracing by tractor in the fertile Matungulu location; this is on colluvial soil below the Matingulu Hills and is the major arable area in the reserve. Some 300 acres were laid out with designed drainage channels protected by grass, and terraced by crawler tractor. The tractor was, however, soon taken by the Department of Agriculture for other work and later sold to the Public Works Department. The area terraced was extended by hand later to over 1,000 acres. The fertility of this area has, however, unfortunately declined in the past 13 years owing to continual cropping without any grass fallow—except a bush fallow on very small patches here and there—and with very little organic manuring. Nevertheless, thanks to a good deal of supervision, the terraces are still mostly in good order and no major erosion has since occurred in this block, although the structure of the soil is now very powdery.

The idea of planned development on the skeleton of an experimental terracing scheme in a limited part of the Machakos Reserve was abandoned over-hastily for the concept that each man throughout the whole 1,000,000 acres of the reserve would take care of his own land if traditional usufruct could be turned into something like outright ownership, and an attempt to do this was made by enclosing the piece each family was occupying by means of a hedge of sisal. Unfortunately African land tenure is too complicated and entangled an affair for its Gordian knot to be cut by such simple means, and 12 years later only a few lines of sisal plants remained which provided fibre from which the local people made rough thread and string. Accordingly, the expenditure of some thousands of pounds yielded no benefit, while increasing erosion in a reserve in which population is rapidly growing has necessitated the importation of famine relief foodstuffs on a large scale during late years.

Progress in the European reserves

During this time some progress had been made in the European areas. Mr. R. O. Barnes and Mr. Wolryche Whitmore, Major F. P. de V. Joyce and Captain F. O'B. Wilson and other farmers had continued to carry out terracing for themselves. Agricultural officers set out terrace lines for some farmers. Terraces were made by wooden V drags, by Martin ditchers, by home-made machines made by converting ploughs, and by hand. A few terracers and graders were in use which were built especially for the job. In 1938 a terracing company was formed in the Trans Nzoia district. This company, with one crawler tractor, broad-base terraced about 1,200 acres of land before the war; but owing to lack of knowledge of methods of maintenance and other reasons very few of these terraces remained 10 years later.

Permanent progress was not made with terracing except on the farms of a few unusually able and progressive men until the Soil Conservation Service begun terracing on European farms at the end of 1940.

A number of farmers continued to pin their faith to belts of Elephant grass planted across fields in such a way as to facilitate ploughing of large blocks, regardless of the contours. These strips held up some silt but encouraged the ingression of running couch grasses and generally had to be removed some 5 or 10 years later when terracing on an orthodox American system was carried out on these fields by the Soil Conservation Service.

(*To be concluded next month*)

British Industries Fair

The 30th British Industries Fair was held at Earls Court and Olympia in London, and at Castle Bromwich in Birmingham, from April 30 to May 11. By reason of the fact that it occurs in the Festival year, the effort has been made to make the Exhibition more than usually attractive and comprehensive. Concerned as it is, mainly with British manufacturing industries, its interest in the agricultural sphere is to an extent secondary and indirect. Nevertheless, there were exhibits which had a direct interest for farmers and planters, notably among the exhibits at Castle Bromwich which are concerned with engineering and hardware, and those at Olympia which comprised, among other things, exhibits from chemical manufacturers.

Among the exhibits at Birmingham was noticed one by Pest Control Ltd., who showed new types of spraying machine; Ransomes, Sims and Jefferies exhibited their MD tractor crawler with various types of plough and harrow for use with it, and the Wolseley Sheep Shearing Co. exhibited a range of electric, vacuum and hand-clipping machines for sheep, cattle and horses, electric fences, loading elevators, etc.

A number of firms, including Imperial Chemical Industries, the Shell Chemical Manufacturing Co., and others, included in their exhibits at Olympia fertilisers and other products used in agriculture.

The Commonwealth section at Earls Court is of particular interest in as much as it included displays by the majority of the Commonwealth governments and an overall picture of the more important products produced in them.

Among the most attractive was a series of stands representing the British West Indies, which included a wide range of tropical products from the various Colonies and a separate stand devoted to the West Indian Sea Island cotton industry.

It is gathered that the attendances at the Exhibition have been very satisfactory and that the volume of orders placed promises to eclipse, when final details are known, the totals obtained in previous years.

Agricultural Diluents

AGRICULTURAL diluents, dispersants, extenders or carriers, to quote the four names by which they are most commonly known, form an important part of all insecticidal dusts and it is a popular misconception that they merely occupy space, are inert and unimportant. Not only are they incorporated in the dusts, but they are also used in a number of wettable spray powders, fertiliser mixtures and soil amendments. The performance of the active ingredient in the dust is more often than not dependent on the efficacy of the diluent used.

Diluents may be very broadly classified under two headings, *i.e.* botanical flours and non-metallic minerals. The former include walnut shell flour, powdered tree bark, tobacco flour and soyabean flour, while under the latter heading there are many more, including silicates, clays, lime products and miscellaneous materials such as gypsum, ground phosphate rock and sulphur.

Sub-divided further, different types of talcs are described as being fibrous, foliated, granular or compact; clays are placed in the categories of bentonite, kaolinite, attapulgite and unclassified; lime products are divided into hydrated and ground limestone—and so on.

The great majority of non-metallic mineral diluents used by the agricultural trade are represented by the silicates and silicas. The botanical flours are of restricted importance.

Effectiveness factors

The following are 14 of the most important factors modifying the effectiveness of diluents, which were described in a recent article appearing in *Agricultural Chemicals** in order of importance: Particle size, density, fluidity, moisture, pH (degree of acidity or alkalinity), absorbing power, compatibility, adhesiveness, specificity, particle shape, toxicity, electrostatic charge, amount used and mixing properties. These factors will be discussed in that order.

Particle size

The fineness of the diluents used in an insecticidal dust has an important effect on the efficiency of the active agent. The few experiments that have been carried out have shown varied results; for instance, three samples of crystalline silica were tested against the grain weevil and it was found that toxicity increased as particle size decreased. With rotenone dusts, however, it appears that small colloidal-sized particles inhibit its toxic value. Another finding has been that particle fineness and density have a direct bearing on distribution and deposit of a diluent dust. Dust groups may consist of 25 to 300 individual particles, and these groups settle on the leaf surfaces but do not stick well. There is probably a considerable amount yet to discover about the behaviour of diluents in relation to active ingredients in insecticidal dusts.

It was formerly thought that materials used to dilute pesticide materials before application were of little importance, apart from their general dilution effect. More recently it has become clear that they may exercise considerable influence on the efficacy of particular materials. Accordingly, the choice of diluent may be very important and the subject is discussed below.

A grinder in operation at a factory where agricultural chemicals are formulated

Density

Depending on whether the dust is to be applied by hand, power or from the air, so the density of diluents varies. Light dusts, weighing 30 to 35 lb./cu. ft., are suitable for machine use provided wind velocity is less than 5 m.p.h. More usually, dusts weighing 35 to 45 lb./cu. ft. are used in ground power dusters and heavier material of 50 to 60 lb./cu. ft. is used in dusts spread by aircraft.

Fluidity

The property of any dust to be free-flowing is naturally an important requirement, and this fluidity is associated with the tendency of the diluent to retain its individual particle size or to form agglomerates. As a general rule, fluidity improves with increasing particle size.

In America it appears that the addition of what are known as conditioning agents often improves fluidity. Wood flour, rosin, tricalcium phosphate and certain silicas are among the materials used for this purpose.

Sometimes the active ingredients have a reducing effect on the free-flowing quality of the diluent and there is much research yet to be done before all dusts have a satisfactory fluidity.

Moisture

It has been found from tests on 61 agricultural diluents that toxicity of mineral diluents and dust mixtures was greater under conditions of high temperature and low humidity than under low temperature and high humidity. Thus, climatic conditions have a considerable bearing on the type of diluent to be used.

pH value

In many cases the degree of acidity or alkalinity of a diluent is important. Alkaline diluents are not recommended to be mixed with organo-phosphates, parathion and tetraethyl pyrophosphates, because they cause rapid deterioration. Addition of a diluent to a dust or spray mixture can change the pH and make it safer for foliage application; however, this may make the dust or spray practically inert, thereby reducing insecticidal or fungicidal activity. Therefore diluents and chemicals must be used not only to achieve commercial control of pests but also in combinations that make the mixture safe to use on foliage.

Agric. Chem., 1950, **5**, 11, p. 43; and 12, p. 45.

Absorbing power

The ability of a diluent to take up a liquid and at the same time maintain a free-flowing condition is termed its absorbing power. Clays are generally the most efficient in this respect, although some may hold the liquid so ' tightly ' that the insecticide is released too slowly to be fully effective. Wettable powders may contain as much as 25% to 50% of the liquid insecticide and in such cases the absorbing power of the diluent is important.

Compatability

Diluents must be chemically, as well as physically, compatible with the active ingredient materials. Certain diluents mixed with certain chemicals have been found to be unsatisfactory; for instance, ferrous iron impurities found in some diatomite diluents react unfavourably with DDT when ground together and one of the chlorine atoms is liberated in the form of hydrochloric acid. The resulting product has little or no insecticidal value.

There is a great field for investigation in this respect. Diluents should be selected and, if necessary, modified to prevent rapid deterioration and chosen for their ability to accentuate killing power.

Adhesiveness

The amount of dust which is lost because of poor adhesive quality can be considerable. For instance, workers found that in orchards 15% to 90% of the dust was lost within 24 hours due to wind, rain and rubbing of leaves. Obviously, any improvement in the staying power of dusts will reduce application rates and, therefore, cost. To increase sticking properties of dusts, the addition of mineral oils of 80 to 110 second viscosity is claimed to be effective.

Specificity

Diluents may be classed in separate groups by broad characteristics; nevertheless samples of the same mineral material from the same mine may vary in effectiveness. The more dependable and uniform a diluent is, the more will it be in demand.

Particle shape

It is believed that the effectiveness of diluents is, to some extent, related to particle shape and a number of workers have reported that fibrous talcs are less effective as diluents than flaky talcs for rotenone dusts.

Toxicity

Although many diluents are completely inert, others do influence the effectiveness of the active ingredient or even have a mechanical effect on the pests themselves. In the latter connection starvation can be effected by clogging the insect's digestive system and penetration of the toxicant can be increased by abrasion of the skeleton.

Electrostatic charge

The majority of diluents develop an electrostatic charge when blown through a dusting machine. This has been found to vary from 0 to 10,000 volts. Some materials develop a lower charge than others, *e.g.* fibrous talc does not develop such a high charge as flaky talc, and as this phenomenon appears to have some relation to dust dispersal it is preferable to use a diluent with a high charge. If a relatively high charge is produced the dispersal of particles on stems and the under surface of leaves is found to be greatly increased.

Amount used

Several workers on the subject have found that comparatively small concentrated applications of insecticide are more effective than heavier rates per acre, using diluents to make up the bulk. For aerial work the less the weight to be carried for a given area the better. Much depends on the adhesive character of the active ingredient; if this is good there is not so great a need for a diluent.

Mixing

As the actual weight of active ingredient in a dust/diluent mixture is very small compared with that of the diluent, it is very important that it should be evenly distributed, otherwise some parts of the plant will receive nothing but diluent. No unmixed particles of active ingredient should be visible in a dust mixture and a sample should be completely smooth when pressed with a spatula.

A homogeniser for making emulsions

Conclusion

From the above it is clear that diluents are not merely inert and unimportant materials having little effect on the performance of the active ingredient. Much work has yet to be done to understand fully the significance of the 14 factors which have been outlined above, but as the problems are gradually solved the effectiveness of insecticidal dusts and sprays will improve. The ' perfect diluent ' may never be found, but there is plenty of room for improvement of the present ones.

Photos: Plant Protection Ltd.

Fertilisers and Rice Potential

An example of what fertilisers can do in increasing rice yields is described in a FAO report by Vladimir Ignatieff, FAO agricultural officer specialising in soil fertility.

In Indonesia, the report states, experiments have shown that the application of 90 lb. of double superphosphate per acre resulted recently in an average increase per acre of 600 to 1,200 lb. of stalk paddy, that is, rice with hulls, plus a little of the stalk.

If this increase were realised uniformly over the entire potash-deficient area in Indonesia, or 1,500,000 acres, the use of phosphate could increase the yield of stalk paddy by some 675,000 tons per year. This roughly corresponds to 338,000 tons of milled rice, ready to cook.

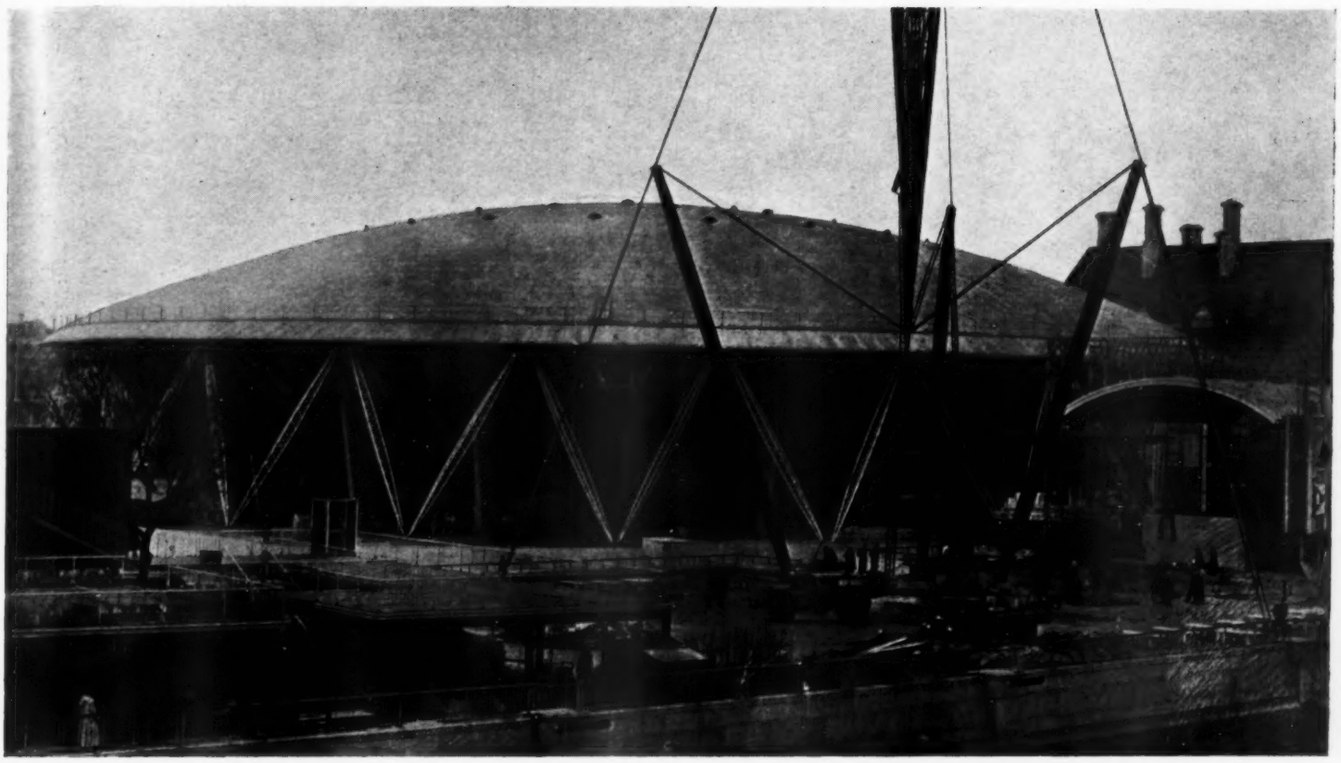
Rust Epidemic of West African Maize

More than 12,000 tons of grain have been imported by the Government of the Gold Coast to meet the food shortage caused by the 1950 epidemic of rust which swept the maize-growing districts of the West African countries between Nigeria and the Ivory Coast.

According to a message from Accra, the epidemic affected the early main crop and resulted in the loss of 30 to 50% of the grain and the disease is still reported as being widespread. The most hopeful news is from the Accra and Volta River areas where it is stated the outbreak has not seriously affected the second crop of the year.

Experience has shown that over long periods rust spores do little harm, but on occasions, an epidemic may start and cause heavy loss of crops.

The Festival of Britain



View of part of the South Bank Exhibition, showing the huge Dome of Discovery and lower part of the Skylon. The photograph was taken from a footbridge which spans the river from Charing Cross

Agricultural Exhibits on the South Bank

FROM the steps of St. Paul's Cathedral on the morning of May 3, His Majesty The King declared the Festival of Britain open. Throughout the summer and autumn the story of Britain, her people and her contributions to civilisation will be told in five major exhibitions in London, two more in Glasgow and Belfast, and at Arts Festivals in 23 towns.

The South Bank

The centrepiece of the Festival is the much talked-about South Bank Exhibition, standing on the curve of the Thames between the bridges of Westminster and Waterloo. Here is the famous Dome of Discovery, a vast concrete, steel and aluminium structure with its 365-ft. diameter dome, the largest in the world; also the strange vertical feature named the Skylon, balanced upon a cradle of cables and towering 290 ft. above the ground. Then there are 19 different pavilions depicting aspects of Britain ranging from power and production to the seaside and television.

Country Pavilion

The Country Pavilion tells the story of British agriculture, the land and the people on it. Starting with the ' Natural Scene,' the visitor walks through 12 widely varying examples of natural topography, vegetation and animal life, from the wild and rocky island of St. Kilda in the Outer Hebrides to the chalklands of the North Downs. Other areas have been selected from a rough line running between these two extremes and include the Cairngorm Mountains of Scotland, Northern Ireland, the Pennine Hills, the South Pembrokeshire coast, Dartmoor and South Devon, the New Forest, the north coast of Norfolk, Suffolk's Constable country and the London area. Each of these subjects is presented in such a way as to show the inter-relation of bird, animal and insect life together with natural vegetation and, in some cases, man's effect on this balance.

Passing on to agriculture, the exhibits start with a series of six dioramas showing the gradual transition of one area of country from 500 B.C. to the present day. A similar and unusual feature is a series of seven wall hangings depicting various types of farming in Britain and giving an effect somewhat like tapestry. The British climate is so well known for its diversity that one need hardly stress the wide range of farming conditions which do exist, from almost ranching conditions in the north of Scotland to the highly concentrated productions in, for instance, the Lea Valley, near London.

Science has its proper place in the Country Pavilion and most of the principal research units have contributed examples of the results of agricultural research as, for example, improved varieties of field crops, fruit and vegetables, soil science advances and selective weed killers. Among the work shown are examples of fertiliser research from Rothamsted, mineral deficiences from Long Ashton, selective weedkillers from Oxford University and plant breeding from the Institute at Cambridge University, fruit development at East Malling and the John Innes Research

Station, and work of the Welsh Plant Breeding Station at Aberystwyth.

Machinery

The machinery exhibits are dominated by four tractors, with ploughs attached, on huge hydraulic jacks about 12 ft. high; throughout the Exhibition these machines will rise and descend 5 ft. every minute for 13 hours a day—certainly a novel method of display.

British farming is the most highly mechanised in the world and a range of machinery for both large and small farms, as, for example, the Massey-Harris artificial manure distributor and the Howard Bantam rotavator, is shown. These exhibits are shown in the east side of the Pavilion which opens on to grass and a strip of water, giving the effect of a Dutch barn, that building which is the storage house for so many farmsteads in Britain and elsewhere.

Forestry

Forestry and land utilisation have their place in the Country Pavilion and here the theme is one of full use of land too poor for crop production. Thus, these non-productive areas are gradually being afforested to supply much needed timber for industry. A section of Snowdonia National Forest Park, in model form, illustrates the relationship between forestry and farming at the different altitudes in these mountainous districts.

Livestock

As the season advances the live exhibits, both stock and crops, will be changed, so so that a complete range of agricultural products will have been on show during the five months. A feature of the livestock section is the ' milk from cow to consumer ' exhibit at which visitors will be able to see cows being milked with up-to-date machines and the milk going through the dairy processes to a milk-bar in the Pavilion, where they will be able to drink it literally straight from the cow.

Discovery and the land

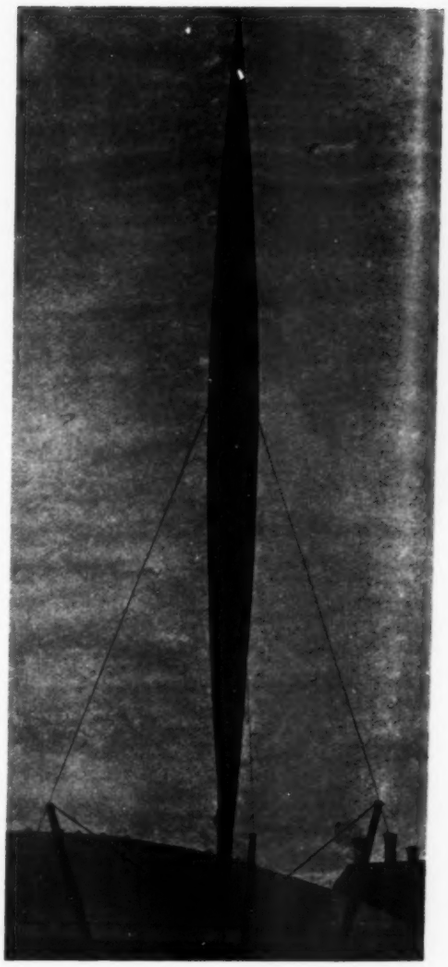
The story told in the Dome of Discovery is British pre-eminence in discovery and exploration, not only by land and sea but into the nature of the living world and the universe. One section is devoted to the land—exploration, map making, land development and Commonwealth agriculture. Here one can see the results of irrigation works at home and abroad, the application of scientific knowledge to tropical agriculture and the work being done to control pests, particularly locusts. An interesting feature, also, is a description of the Commonwealth Agricultural Bureaux and how they enable a free interchange of ideas and information to take place between one country and another.

Imperial Institute exhibitions

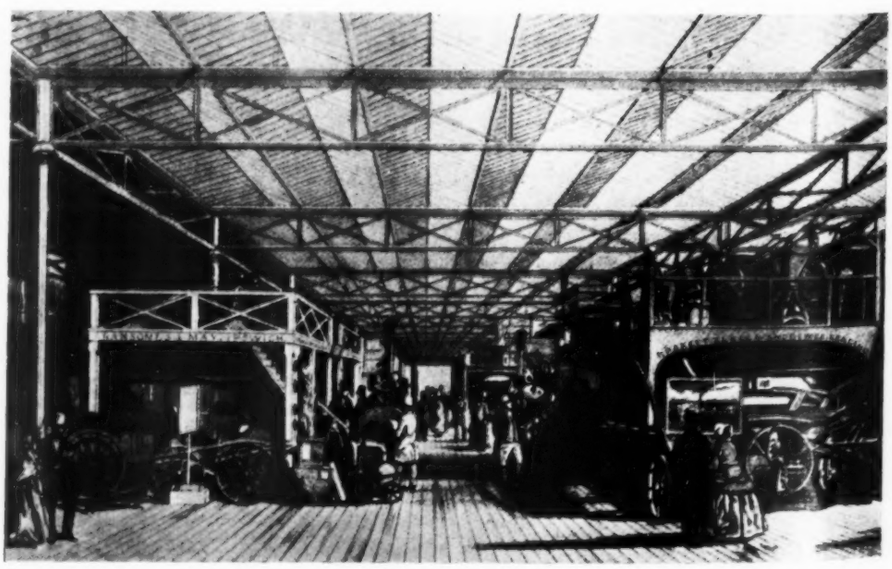
The Dome only gives the visitor a glimpse of the Commonwealth, but there are two other exhibitions in London, at the Imperial Institute, which illustrate in detail the relationship between Colonial peoples and the people of Britain; one of these exhibitions is called ' Focus on Colonial Progress.' The four exhibition galleries of the Institute enable the visitors to ' walk round the Commonwealth ' and study the lives and livelihoods of the many Commonwealth peoples.

Farm and Factory

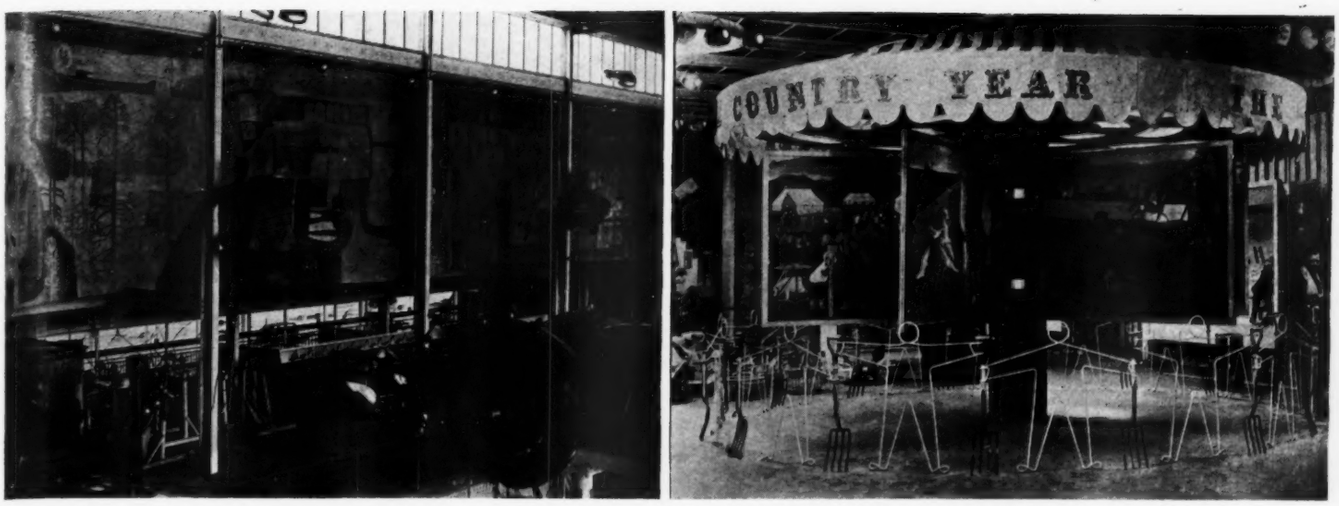
On June 1 the Ulster Farm and Factory Exhibition will open for three months and ranks as one of the official Festival Exhibitions throughout the United Kingdom. It will take place in the interior and grounds of a model factory on a new trading estate near Belfast; one-third of the indoor space and two-thirds of the outdoor space will be devoted to agriculture. One of the principal features will, of course, be the story of the Irish linen industry. A large part of the grounds will be occupied by the Farm of the Future, a full-size working exhibition of a farm, complete with livestock, and a layout designed for a 40-acre Northern Ireland



Towering 290 ft. above the ground is the Skylon — at night illuminated throughout its entire height



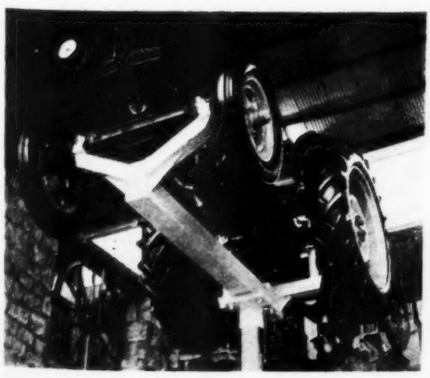
Flashback to 1851: the machinery annexe at the Great Exhibition, held in London's Hyde Park



Two scenes taken inside the Country Pavilion. On the left can be seen two of the sculptings illustrating the four seasons; on the right a ' merry-go-round ' illustrates various phases of the country year

View from the upper gallery inside the Dome of Discovery

One of the wall hangings illustrating one type of British farm



Fordson tractor mounted on a hydraulic ram 12 ft. above ground

holding. This exhibit will represent the combination of practical requirements and modern architecture in a labour-saving layout.

This exhibition will be the largest display devoted to agriculture in any of the Festival of Britain exhibitions, which do not, of course, include the annual agricultural shows.

Dr. Slade Wins R.S.A. Prize

The Royal Society of Arts' prize of £500 and a gold medal for ' a means of promoting the production or the economic utilisation of food in Britain ' was awarded to Roland Edgar Slade, M.C., D.Sc., F.R.I.C., of Bishops Stortford, Herts, who submitted a scheme for two systems of farming, one for grassland and the other for arable land. On the recommendation of the judges, a silver medal was also awarded to the runner-up, Rex Munro Paterson of Basingstoke, Hants, for his simple system of grassland recording. One hundred and fifteen entries were submitted.

The prize and medals were presented by H.R.H. the Princess Elizabeth, President of the Society, on May 1, when she attended the Society's house to open the Exhibition of Exhibitions.

Dr. Slade, a chemist by profession, is now a farmer, and was Controller of Research, Imperial Chemical Industries Ltd., from 1935-45. Mr. Paterson farms in Hampshire and Sussex.

Festival Centenary

One of the few firms to have had their products displayed at both the 1851 and 1951 exhibitions is the old-established Ipswich firm of Ransomes, Sims and Jefferies, Ltd. Their history dates back to 1789 when the founder, Robert Ransome, started his iron foundry for the manufacture of ploughs. Since that time Ransomes have played a leading part in the development of a varied range of manufactures.

By 1851, the year of the Great Exhibition, Ransomes were already making nearly 100 different types of implements for cultivation of various crops all over the world. At the 1851 Exhibition they won several premier awards.

Manufacture of the first lawn mower was commenced in 1832, the first steam plough in 1850, the first petrol-driven lawn mower in 1902, the first electric truck in 1923, and the first electric lawn mower in the early 'twenties.

The country scene, with teams of horses, has however, been transformed by the internal combustion engine. Life and conditions have changed and it is obvious that the appetites of those living over 100 years ago would not be appeased with our austerity diet. For instance, in January 1849 Ransomes celebrated an extension to their Ipswich works by entertaining 1,500 employees and guests. Carefully preserved records show that nearly two lb. of meat per person were consumed, whilst the amount of ale consumed amounted to 12 barrels.

The firm is still expanding and Ransomes have recently built an entirely new foundry on the outskirts of Ipswich.

The Mineral Nutrition of Crops

With Special Reference to Fruit Crops

Part II

Prof. T. WALLACE, C.B.E., M.C., D.Sc., F.R.I.C.

Director, Long Ashton Research Station, University of Bristol, England

This is the second part of Professor Wallace's Cawthron lecture. In it he discusses soil conditions as they affect the supply of nutrients to crops and the special problems of the mineral nutrition of tree fruits and orchards.

THE supply of mineral nutrients to plants is affected by a number of soil factors and, in this connection, the following points are of particular importance:

(i) The fixing power of soils for nutrients.

(ii) The effects of soil acidity and alkalinity.

(iii) Organic matter, drainage conditions and aeration.

The fixing power of soils

The organic matter and clay fractions of the soil, by virtue of their colloidal properties and chemical constitution, are able to react with mineral nutrients and compounds containing them in a number of ways that affect both their solubility and availability to plant roots. Thus these two fractions can remove the nutrients very largely from the soil solution by physico-chemical adsorption and by chemical reactions. Following such changes the nutrients may remain in forms in which they are still fairly readily absorbed by plant roots, *e.g.* in the form of exchange kations and anions, but a proportion may be rendered practically unavailable to plants as the result of more complex reactions. All these fixation processes prevent the rapid leaching of nutrients through soils by rain and are particularly well marked for phosphorus and potassium. Fixation processes thus have both a credit and a debit aspect, but in many instances, especially for phosphorus, an important result is that a considerable proportion of added nutrients is never recovered in the crops. Where fixation processes are pronounced for certain elements, the most efficient method of applying nutrients may be by foliage sprays or tissue injections. The high fixation of phosphorus has led to the common practice of combined drilling of phosphates with seeds and to other methods of fertiliser ' placement.'

In addition, biological fixation due to soil organisms is important on some soils for certain elements, *e.g.* manganese over the pH range of approximately 6.0-7.8, as shown by Quastel.*

* Quastel, J. H., 1946. Soil Metabolism. Lecture, Royal Institute of Chemistry, London.

Typical rosette formation (little leaf) of apple caused by zinc deficiency. Note the small narrow leaves

Effects of soil acidity and alkalinity

The natural reaction (pH) of soils serves to characterise to a great extent the supplies of soil nutrients and their availability to plants.

Thus, strongly acid soils contain relatively low contents of the basic nutrient elements, calcium, potassium and magnesium, and the availability of nitrogen and phosphorus is usually low. Trace elements may be readily leached from them, though their availability, with the exception of molybdenum, is high. These soils also contain excessive amounts of available manganese, aluminium and hydrogen ions, these last-named being the true measure of acidity.

In soils of alkaline reaction, due to calcium carbonate, supplies of calcium are high and the conditions are generally suitable for high availability of nitrogen and phosphorus. Supplies of magnesium and potassium are variable according to the chemical nature of the parent rock. The availability of trace elements is generally low, with the exception of molybdenum. High alkalinity may also result from sodium carbonate in arid soils and in these soils calcium may be low and sodium abnormally high.

The special features of acid soils give rise to problems of particular practical interest in connection with crop failures on them. At Long Ashton the causes of such failures for different crops have been investigated and we have been able to show that the main causes of failure for different crops are different. Thus potatoes have been found to be particularly susceptible to deficiency of calcium and the field symptoms agree well with this finding; Brassica crops are especially affected by excess manganese, and celery, carrots, sugar beet and leeks by excess aluminium.

It has also been shown that a particular trouble may be intensified by the presence of the other deleterious factors, *e.g.* manganese toxicity of Brassica crops, by excesses of aluminium and hydrogen ions, thus showing the complex nature of acidity problems as they occur in the field.

Similarly, on calcareous soils, where trace elements are generally low in availability, different deficiencies often result in different crops, showing that the various deleterious factors in alkaline soils also need careful examination in considering crop failures associated with soil alkalinity.

An important point in connection with soil reaction is that troubles due to trace element deficiencies and excesses may often be readily controlled by regulating the soil pH. For this purpose liming provides the standard treatment for correcting acidity and sulphur may be used

Soil acidity factors in relation to sugar beet. (*Top left*) **Manganese toxicity, note some dwarfing and chlorotic mottling.** (*Bottom left*) **Aluminium toxicity, severe stunting and plants of phosphorus deficient type.** (*Right*) **Calcium deficiency, restricted growth of young leaves, with eventual failure of laminae to develop**

to decrease alkalinity. (The expense of using this latter substance must, however, be carefully considered.)

Organic matter and drainage

These factors are of importance in regulating the availability of nutrients in the soil and they also affect the absorbing properties of root systems.

Organic matter produces large effects on soil structure and also determines in large measure the nature and numbers of the soil organisms. It also acts as a very efficient storehouse for mineral nutrients by virtue of its powers of absorption. As regards its effects on the availability of individual nutrients to plants, it may increase the availability of iron, and may decrease the availability of manganese, copper and zinc, possibly through the action of the soil organisms it supports. It may also regulate nitrogen supplies by providing the organisms with carbohydrate materials as sources of energy which enable them to utilise soil nitrogen supplies and temporarily to deplete available nitrogen.

Drainage affects both the water content of the soil and the complementary soil atmosphere, and hence drainage and aeration may be considered together. The soil water may directly affect the supply of nutrients by its solvent properties and by its movement through the soil, but its effects on aeration conditions are also important. Thus the water content determines whether or not conditions in the soil will be aerobic or anaerobic. Under aerobic conditions oxygen supply is high—a condition which favours the efficient root action of the large majority of crops. Certain elements, however, notably manganese, may have a relatively low degree of availability under aerobic conditions owing to their favouring oxidation processes. In soils of high water content (*i.e.* waterlogged, anaerobic conditions) the oxygen supply is often inadequate for the proper functioning of plant roots and in addition harmful effects may arise from high concentrations of carbon dioxide in the soil. Waterlogged conditions are generally associated with high availability of iron and manganese, but they produce deleterious effects on the absorption of other nutrients, particularly potassium, nitrogen, phosphorus and calcium. These harmful effects may lead to disappointing results in attempting to correct nutrient deficiencies on ill-drained soils.

Particular requirements

It is possible to generalise to some extent on certain points relating to the nutrient requirements of different classes and varieties of crop plants and this information can be of great practical use in considering cropping programmes and manurial treatments. The Brassica crops, as a class, have high requirements for nitrogen, phosphorus, calcium, magnesium and boron (also for molybdenum), whilst some members of the class also show special requirements for a particular element, *e.g.* cauliflower for potassium. Most Gramineae have especially low requirements for boron and this element is unimportant in manuring them. Legumes show high requirements for phosphorus, calcium, potassium, zinc, boron and molybdenum (also for nitrogen, supplied by the nodule organisms). Fruit crops in general, and apples in particular, require high amounts of potassium, magnesium, iron, manganese, copper, zinc and boron. Other special requirements of fruit crops are: pears, iron; cherries, manganese; citrus, nitrogen, magnesium and zinc.

Examples of special varietal requirements are: potatoes (varieties grown in Great Britain), Majestic relatively low and Kerr's Pink relatively high requirements for mineral nutrients; beetroot, globe varieties high and long varieties low manganese requirements; apples, Cox Orange Pippin, Grenadier, Beauty of Bath, high potassium requirement, and Sweet Alford high requirements for magnesium and manganese.

In tree fruits, special nutritional problems also arise due to rootstocks. Thus among the Malling clonal apple rootstocks Types V, II, VII and IV are susceptible to potassium deficiency and Types I, IX and IV to magnesium deficiency.

Special fruit problems

Fruit crops present several special problems of nutrition which must receive attention in order to obtain favourable results in the orchard.

Since fruit plants are perennials and occupy a given site for a period of years, the nutritional programme must be planned and adjusted to the various stages of the life of the orchard. Nutrient requirements alter with the age of the plants; they have growth and fruiting phases and an important objective must generally be longevity. In the early stages of growth, deficiencies of potassium and phosphorus may require particular attention, whereas in later years low levels of nitrogen and magnesium may present the main problems. The necessity for longevity usually means that the methods used in providing a satisfactory mineral status must also aim at maintaining or even raising the general level of soil fertility.

Rootstock and scion effects

Tree fruits usually consist of parts of two distinct varieties—the scion and the rootstock—each with its own varietal peculiarities but subjected to interactions. Thus both rootstock and scion may

influence the nutrient requirements; for example, apple varieties on Malling No. V are especially susceptible to potassium deficiency, when a range of rootstocks worked with a single scion variety is compared; whilst when a number of varieties on a given rootstock are compared for reaction to potassium, Cox Orange Pippin, Grenadier and Beauty of Bath will be found in the highly susceptible group. Combinations of two susceptibles are likely to result in highly susceptible trees and may provide very difficult problems of nutrition and cause financial loss.

Vegetative growth and fruitfulness

Fruit trees are grown for their fruits and the vegetative growth must be adjusted to provide the best conditions for fruit production. It is thus important to know how each element affects these two points. This can be ascertained from a knowledge of the effects of deficiencies and excesses of the elements. Thus, nitrogen and phosphorus are of fundamental importance for the production of vegetative growth and for fruit bud formation, whilst potassium is not so important in promoting lateral growths or fruit buds.

It is especially important to appreciate the large and speedy responses obtained in fruit trees from nitrogenous dressings and the effects of these on growth and fruiting according to the vigour of the trees.

Yield and quality aspects

Quality is often of great importance in fruit crops and it may even be necessary to produce fruits with very special points of quality, *e.g.* firmness, size, colour, long keeping, and good transport quality.

In some crops high yields and desirable points of quality may not be achieved by the same nutritional status, *e.g.* by high general level of manuring, and it is thus necessary to know how both yields and quality factors are affected by the various nutrient elements. It can be stated that each element produces specific effects on quality; important examples of deficiency effects are as follows: nitrogen, highly coloured firm fruits, usually with high sugar content and good dessert and keeping properties; phosphorus, soft, highly acid and unpleasant flavour; potassium, often immature appearance and flavour subacid and sweet; magnesium, immature appearance, woody and flavourless; boron, deformed fruits, affected with skin and flesh troubles such as pitting and gumming.

Special requirements

Fruit crops generally present more problems relating to mineral nutrients other than nitrogen, phosphorus and potassium than do common farm crops. They usually also have especially high requirements for potassium. In practical orcharding, nitrogen, potassium, magnesium, iron, manganese, copper, zinc and boron all present important problems. Phosphorus is often of less importance than for farm crops, but in view of the serious effects which result from a deficiency of this element a satisfactory level should be maintained in orchard soils. The need for calcium varies with the different fruits and some grow well on acid soils with low calcium status, *e.g.* apple. Black currants have a high calcium content and may fail from soil acidity.

Some special requirements of particular crops are as follows:

Apples: K, Mg, Fe, Mn, Zn, Cu, B.
Pears: N, Fe (particularly on quince rootstocks); probably also Cu.
Plums: N, Fe.
Cherries: Mn.
Black currant: N, Ca.
Red currant: K.
Gooseberry: K.
Raspberry: K, Fe, Mn.
Strawberry: P, Fe.

Potato plants in sand culture illustrating the beneficial effect of potassium when iron supply is low. All plants same low level of iron. Centre plant, low potassium; right plant, medium potassium; left plant, high potassium

Effect of cultural practices

The main cultural practices in fruit growing comprise permanent sod, arable culture with cover crops and arable without cover crops. Of these, the extreme conditions are represented by sod culture and arable without cover crops, and the general effects of cultural practices may be illustrated by a comparison of the effects of these two systems. Sod culture (also most cover crops) tends to lower the nitrogen status of the fruit trees, but if the sod method is combined with frequent cutting of the herbage and the cuttings left to rot *in situ*, this effect is minimised though not usually wholly overcome. Sod plus cutting technique also appreciably raises the potassium status and may also raise the level of phosphorus. Effects on magnesium status are likely to be variable as the lowered nitrogen conditions are likely to reduce the magnesium level whilst available magnesium in the soil may be raised by the cutting treatment. Iron status is definitely raised by sod culture where the element is deficient on calcareous soils but no such beneficial effect has been noted for manganese. Effects on other elements have not been examined.

The main beneficial effects of arable culture occur during the early years of the orchard when it generally results in a high nitrogenous status. The level of this element under this system may, however, show a steady decline in later years as the organic matter becomes depleted as a result of the continued cultivation.

Problems of application

Special problems of applying mineral nutrients result from the size and growth habits of the root systems of the trees and

in connection with the different cultural practices that are followed.

In general, trees under sod culture need higher dressings of nitrogenous fertilisers than under cultivation, but they may need less potassium and phosphorus, and if iron is a problem on the particular soil type no special treatment may be required on trees under sod.

The methods of applying mineral nutrients to fruit crops are of importance. Nitrogen, potassium, phosphorus and boron can all be effectively applied broadcast over the root range of the trees and, under arable conditions, where ploughing is practised, may be ploughed under to obtain quick responses (particularly potassium and phosphorus).

Magnesium may be applied to the soil as magnesiam limestone or as magnesium sulphate (Epsom Salts), but responses from soil treatments may be very slow and, where an acute deficiency of the element occurs, foliage sprays, using 2% magnesium sulphate plus a spreader, will generally be more effective. The trace elements, iron, manganese, copper and zinc, are all most effective when applied as sprays (usually to the foliage) or injected in the form of solid salts into the trunks or branches, and may not be effective if applied as soil dressings on calcareous soils. The most efficient method of applying zinc to deciduous fruit trees is by means of dormant sprays.

Calcium is, of course, most suitably applied by the usual liming methods, preferably before planting the fruit. Sulphur may be given as sulphate in the usual sulphate-containing fertilisers.

Should molybdenum ever be needed it would be most suitably applied as a molybdate in a foliage spray.

Conclusion

It is obvious that the mineral nutrition of crops raises many difficult practical problems. Empirical methods of approach will often be very inefficient and expensive, and frequently ineffective. Moreover, it must be remembered that mineral nutrition is influenced by many factors other than manuring, including management practices, and that these may profoundly affect the mineral status of crops, and especially of fruit crops where management involves very detailed operations even on individual trees.

Photos: Long Ashton Research Station.

Crop Protection Conference Organised: Advisory Centre Opened

A conference with the title of 'Some Crop Protection Problems in World Agriculture' will be held at Fernhurst under the auspices of Plant Protection Ltd., between June 26 and 28. It will cover many aspects of the control of pests, diseases and weeds, the wastage of world food supplies through pests and diseases, and the factors limiting progress in crop protection at present.

Among those who have promised to contribute papers or take part in discussions are: Sir John Russell, F.R.S., Dr. H. J. Page, C.M.G. (Principal of the Imperial College of Tropical Agriculture), Dr. W. G. Templeman, Dr. L. M. Stahler (South Dakota State College), Dr. K. M. Smith, F.R.S., Mr. F. C. Bawden, F.R.S., Professor D. J. Keunen (University of Leyden), Dr. E. Rivnai (Rehovoth Research Station, Israel), Professor Visocchi (Federazione Italiana del Consorzi Agraria) and Dr. R. Poutiers (French Ministry of Agriculture).

The conference is therefore international in scope and promises to be of considerable importance. We hope to include an account of it in a subsequent issue.

New advisory centre

The inauguration by Plant Protection Ltd. on April 9 of an advisory centre at Bury St. Edmunds, in Suffolk, marks another step in the policy of the company. Already similar centres have been established by them in Maidstone, Bath, York and the Channel Islands and it is therefore the fifth in the series.

The aim is, on the one hand, to bring the knowledge, products and facilities which the company have to offer to the doors of the farmer, and on the other, to make available first-hand knowledge of practical agricultural conditions and the problems needing a solution to their research workers at Fernhurst and Hawthorndale, working throughout in close association with the National Agricultural Advisory Service.

Mr. R. J. Gutsell

Speaking at the inaugural lunch, Sir William Gavin expressed his pleasure at seeing such firms as Plant Protection getting out into the country and serving the needs of their customers on their own land rather than from a London office.

The centre is intended to serve the whole of the Eastern counties; it is situated in converted buildings in Bury St. Edmunds, and is in charge of Mr. R. J. Gutsell, formerly horticultural adviser for the county of Norfolk.

Among those present at the lunch were the Earl of Cranbrook, Lord Cranworth, Mr. T. R. C. Blofield, chairman of the Norfolk County Agricultural Executive Committee, the Mayor of Bury St. Edmunds, Mr. J. Anderson, provincial director of the N.A.A.S., and Sir William Ogg, director of Rothamsted Experiment station.

Following the luncheon, Mr. C. Kingsley, county agricultural advisory officer for West Suffolk, conducted a brief tour of farmland round Bury and visitors saw how crops have been affected by abnormal weather and what cultivations have been successful. The tour included glimpses of mangold and potato clamps, winter-sown corn, peas, clover leys, reseeded pasture, the beginnings of the new water scheme, some superb Suffolk hedging, and in passing, a number of interesting historical buildings. Mr. Kingsley and his assistants answered various questions put to them on agriculture in West Suffolk.

Labour Force Returns

Results of the December agricultural returns in England and Wales show that the total number of workers returned as employed on agricultural holdings exceeding one acre was 672,000, a reduction of 20,000 compared with December 1949. In regular males the decline was 15,000, but casual male workers increased by about 1,000. Regular female workers increased by about 4,000 and casual females by over 2,000. The December 1949 returns, however, had included 12,000 members of the Womens' Land Army.

Research on the Coconut Palm

With Special Reference to Ceylon

R. CHILD, B.Sc., Ph.D. (Lond.), F.R.I.C.

Formerly Director, Coconut Research Scheme, Ceylon

We have previously published articles on the coconut industry, notably one by Dr. Child on production in Ceylon, which appeared in March 1950. Taking the long view, permanent crops like coconuts offer the best prospects for rapidly increasing world supplies of vegetable oils and fats, and research directed towards increasing their yields is therefore particularly important. The following is an abbreviated version of a recent paper by the same author, reviewing coconut palm research.

THE world area under the coconut palm is credibly estimated at not less than 10,000,000 acres, carrying some 500,000,000 bearing trees and producing annually an edible oil equivalent of about 3,000,000 tons.

The five large producing areas of Indonesia, the Philippines, Ceylon, Malaya and Oceania provide 90% of the world's exportable coconut products. India, a large producer, consumes all its own production, and is now in fact a considerable net importer. In all these localities much *ad hoc* research has been carried out, mainly concerned with the empirical solution of local problems.

Systematic long-range applied research on the crop is of recent origin. From about 1906 the palm has been studied in the Philippines. Much information has come from the four stations of the Department of Agriculture, Madras. A research scheme with a full-time staff commenced work in Ceylon in 1933. In 1929, the Department of Agriculture, Straits Settlements and Federated Malay States, appointed a full-time officer for research on coconut products. Entomological work in Fiji has provided good examples of biological control, and stations in Indonesia carried out much work on coconut palms, including one entirely devoted to the crop, which was under the direction of Dr. P. L. M. Tammes.

Pests and diseases

As with many tropical crops, the earliest problems demanding attention related to pests and diseases. Lepesme noted in 1947 that 751 species of insects were on record as attacking or infesting the coconut palm, but of the 751, fortunately only a few are serious pests, and where these are not adequately controlled it is usually not because of lack of knowledge.

A coconut nursery

For example, the control of the black beetle, *Oryctes rhinoceros* L., and that of the red weevil, *Rhyncophorus ferrugineus* Ol., are matters of plant sanitation; in the former the disposal of dead trees and all organic matter that can serve as breeding places; in the latter prompt attention to wounds and injuries which provide entry for the weevil.

The coconut scale, *Aspidiotus destructor*, common in India and Ceylon, rarely causes serious damage, being controlled by its natural enemies, particularly the small blue-black ladybird beetle, *Chilocorus nigritus* F. In some countries, notably Fiji, it became introduced without its natural enemies and caused serious losses.

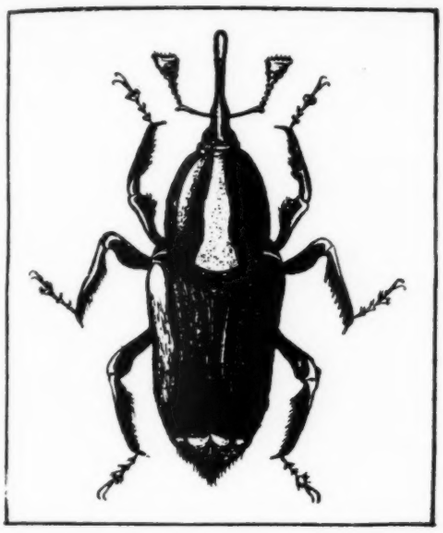
It is normally neither practicable nor economic to control coconut pests by the use of insecticides. Various species of caterpillar attack the coconut palm, some seriously, and with some of these biological control has achieved striking results. The control of *Levuana iridescens* Baker, a moth confined to Fiji, by the introduced parasite *Bessa remota* Aldr. has become a classic example of this type of work.

A less well-known example is the partial control of the black-headed caterpillar, *Nephantis serinopa* Meyr., in the Eastern Province of Ceylon by the Eulophid parasite.

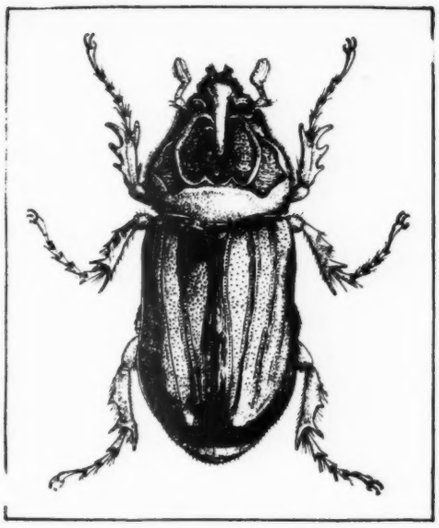
In the main producing regions, the coconut palm is affected by few serious fungal, bacterial or virus diseases, and there has been little recent work on them.

Bud rot. True bud rot is regarded as caused by the fungus *Phytophthera palmivora* Butler, which was recorded on coconut, areca and palmyra palms in Madras in 1906. Since then, in most coconut-growing countries bud rot due to Phytophthera spp. has been described, but it does not appear to be of extensive economic importance; in India it is only sporadic, and in Ceylon, Park and Fernando describe it as of rare occurrence. Sharples in 1924 asserted that no true fungal or bacterial bud rot occurred in Malaya, but that the condition so called was the consequence of damage by lightning; any organisms isolated from dead specimens resulted from secondary infections.

Tapering. Briton-Jones describes a condition known as ' tapering stem wilt,' and refers to the picturesque name given in Jamaica, ' pencil-point disease.' The characteristics of what is known in Ceylon as ' tapering disease ' are a diminution of the diameter of the trunk, with a corresponding dwindling of the size of the newly emerging fronds, until ultimately the palm



Rhynchophorus schach Oliv. **(Length about 33 mm. exclusive of rostrum)**



Oryctes rhinoceros L. **(Length about 40 mm.)**

dies. In many cases it is possible to refer these symptoms to fairly obvious cultural conditions such as hard-pan, waterlogging, soil deficiencies and senility. There remain cases where such factors are not operative, and further study is needed.

Nut fall. The coconut palm produces new flowering branches at approximately monthly intervals; the female flowers appear at the base of the panicle; above them are the numerous male flowers. From the emergence of the spadix to complete maturity of the fruit takes 12 to 13 months; at any one time, therefore, the palm is carrying 12 or more bunches at successive stages of development.

The fall of immature nuts within two months of the emergence of the spadix is a normal phenomenon, since far more female flowers are produced than the palm can bring to maturity. Gadd quoted figures of 29 to 35% of female flowers reaching maturity, and similar figures were obtained in the Ceylon Coconut Research Scheme's principal manurial experiment.

On very poor soil, much higher percentages of set from smaller initial numbers of female flowers per spadix were recorded. Fertiliser applications which increased the total crop did so by increasing in greater proportion the initial number of female flowers; the percentage maturing was decreased.

The fall of immature nuts at a later stage often causes considerable losses of crop, which should be preventable; nut fall at three or four months' development is common. It is often heavy after unusually prolonged dry weather, and may especially occur with the onset of the first rains. Park and Fernando therefore advocate measures aimed at improving the water-holding capacity of the soil. *Phytophthora palmivora* Butler is suspected of causing nut fall, especially of nuts of full size but of immature development (six to eight months). An obvious predisposing factor is weakness of the bunch stalks; a bunch of immature nuts may weigh over 50 lb., and actual breakage of the stalk may occur. For this reason, seed nuts which are selected from mother palms have short sturdy bunch stalks.

Genetics and seed selection

The diploid chromosome number of *C. nucifera* 2n—32 has been reported by Santos and E. J. Janaki-Ammal. The number of distinct varieties of the coconut palm has not been exactly determined, partly because of the difficulties involved with a plant of such wide distribution and partly because of the lack of genetical purity due to natural cross-pollination. Almost all the palms grown commercially are ordinary tall varieties. Dwarf types have been grown on a limited plantation scale, especially in Malaya, but experience in Ceylon has not been favourable.

In the principal coconut-growing countries, seed nuts are selected from high-yielding mother plants. Because the male parent is unknown and because the female parent is itself heterozygous, there is no guarantee that the performance of a high-yielding palm will be reproduced in its progeny. Selected palms should therefore be subjected to extensive progeny testing, and subsequently crosses between proved parent trees should be planted. It is obvious that, owing to the long interval between generations, work of this type can be carried out only by research stations with prospects of long continuity. So far, in no country has coconut breeding progressed far enough to give any noteworthy results applicable to large-scale practice.

In Ceylon, Pieris studied various characters of the palm and laid down criteria for a good parent-palm. In 1935 an area of five acres was planted with 292 seedlings, the progeny of nine palms having these characters; this area is now yielding over 12,000 nuts per annum, and in 1949 a comprehensive progeny test was laid down with seedlings therefrom.

Pending the results of such experiments, one can only recommend the use of seed nuts from selected high-yielding mother palms with other desirable characters; such nuts having at least a somewhat greater chance of giving superior progeny. In view of their lack of genetical purity, rigorous culling of seedlings in the nursery is also recommended. Other work initiated by Pieris has provided some experimental support for this practice. Field investigations in the Philippines, Ceylon and elsewhere have provided a sound basis for nursery management and transplantation, though there is some variation in recommendations made for the latter. Ordinarily in Ceylon it is recommended that seedlings should be planted out after about 30 weeks in the nursery, when two or three leaves have developed.

Germination

An investigation under the Coconut Research Scheme (Ceylon) showed that there is little difference in weight, whether of total or of dry matter, between a seven-month-old seedling ready for transplantation and the original seed nut.

The carbon compounds in the food reserves of the seed are adequate up to the transplantation stage; the plant is also self-supporting in nitrogen. It had been supposed that ample potash would be available, owing to the accumulation of this element in the husk, overlooking the rapidity with which potash salts are leached out. Coconut roots do not ramify much in the husk, but mostly go straight through it into the soil; by the time they arrive there (which may be 16 weeks or more after the nut has been put down in the nursery), if much rain has occurred in the interval, residual potash may be inadequate. It was found, in fact, that application of potash fertilisers to nurseries at a convenient stage had a marked effect on seedling growth.

Manuring

Until recently few systematic manurial experiments on the coconut palm had been carried out, though empirical information of local value was available. Salgado has

reviewed earlier work and summarised the results of trials carried out in Ceylon since 1934.

Joachim, Pieris and Salgado, working on different data, agreed that the optimum plot size, consistent with a minimum standard error, was one of 18 trees occupying, as ordinarily spaced, about 0.3 acre. In their experiments in Malaya, Belgrave and Lambourne adopted a split-plot design, using 16-tree plots for cultivation treatments and sub-plots of only four trees for manurial treatments; this may account for the lack of significant effects.

The principal manurial trials under the Coconut Research Scheme in Ceylon are: On the main experimental station at Bandirippuwa Estate, Lunuwila, a 3 × 3 × 3 factorial N.P.K. experiment, started in 1934. On the sub-station at Ratmalagara Estate a similar experiment on an area newly planted in 1948, and a 3 × 2 × 2 K. × P. × Cultivation (ploughing *v.* no ploughing) experiment laid down in 1943. On co-operating private estates randomised block experiments of a simpler types have been conducted since 1939.

Potassium

Has been established as a dominant requirement of the coconut palm. In the Coconut Research Scheme's main experiment, applications of 0.75 lb. K_2O per palm in alternate years gave a significant response in the fifth year (1940) and every subsequent year, and applications of 1.5 lb. K_2O per palm every other year, in the third year (1938) and subsequently. Even on the comparatively good soil of these experimental areas, potash at the higher level has maintained from 1942 to 1947 an average increment of yield of nearly 40% of over 4 cwt. of copra per acre. Since 1940 the increases of yield have not been linear; from 1942 to 1947 inclusive, the K_1-K_0 response has averaged 340 lb. copra per acre, and the K_2-K_1 response 128 lb. Larger applications may therefore be uneconomic; a third and higher level of potash is being used in the new 3 × 2 × 2 experiment which should give further information.

The husks and nut water from plots receiving potash show a content of this element significantly higher than those from plots receiving none. From the possibility of its use as a diagnostic, the nut water potash has received particular attention. The potash content of the nut water increases almost linearly with the doses of potash applied.

Phosphorus

Neither in Foster's experiment, in which a soluble phosphate was used over four years, nor in the Ceylon factorial experiment, where Saphos phosphate has been applied every two years from 1935 to 1949, has the slightest response to phosphate been obtained. Both of these trials were on comparatively fertile soils, which had, moreover, for some years prior to the start of the experiments received regular large applications of phosphatic fertilisers.

On poor lateritic gravels, on the other hand, which contained initially only traces of available phosphate, almost spectacular responses were obtained to applications of phosphate equivalent to 0.6 lb. P_2O_5 per palm every two years. The long-continuing residual effect of phosphatic fertilisers is noteworthy. Eden found that even four years after phosphate applications to Ceylon tea soils weed growth (in terms of dry matter) was over 100% greater than on unmanured plots and, as Eden suggests, the behaviour of phosphates in tropical soils needs more scrutiny than it has had in the past.

Nitrogen

In the Ceylon factorial experiment significant responses to nitrogen were at first obtained, but with the higher dose of 1.0 lb. N. per palm did not continue after 1938, nor with the dose of 0.5 lb. N. after 1942. It seems likely that under the cultivation regime adopted on the experimental area there is an accumulation of nitrogen in the soil which renders further applications in the form of artificials unnecessary. No cattle grazing is permitted. The sward, which includes grasses and legumes, is harrowed twice a year and ploughed in every other year. Calculation from the analysis of pasture samples showed that the biennial ploughing incorporated *inter alia* into the soil 46 lb. of nitrogen and 43 lb. of potash per acre. There is little doubt that excessive amounts of nitrogen depress yields.

Coconut palm, showing method of fruiting

Trace elements

There is little information on the coconut palm's requirements of other elements. Application of iron salts has been claimed to increase the yield of palms growing on coral islands. Innes found no evidence that manganese deficiency was a cause of diseases on the leaf and inflorescence; he reported that the limit of adequacy for manganese in coconuts (leaf and inflorescence) was probably not above 10 p.p.m. The coconut fruit has been found to contain little or no boron or zinc. The Coconut Research Scheme (Ceylon) is studying tapering disease from the point of view of possible mineral deficiencies.

Cover crops

From 1937 to 1949 an experiment was carried on at Bandirippuwa Estate on the effect of growing a cover crop (*Centrosema pubescens* Benth.) between coconut palms; it consisted of six randomised blocks of six plots designed to compare the treatments, no cover + N.P.K., cover + K., cover + N.K., cover + P.K., cover + N.P. and cover + N.P.K.

The cover crop produced a sharp decline in yields which reached a maximum in the third year; this was probably connected with a severe drought in 1938. The incorporation into the soil of the cover crop with added fertilisers at the end of 1939 resulted in a recovery in the fourth year of the experiment, which was subsequently maintained. Since then the only significent difference has been the short fall of yield on plots receiving no potash.

The results of this trial do not suggest that on a short-term basis the growing and control of a specific cover crop give superior results (on lateritic gravel under the conditions of the experiment) to harrowing and ploughing of the natural sward. Extended study is required of cover crops and green manures.

An experiment on growing Napier grass as a subsidiary crop between palms (1939-43) indicated that even with manuring yields of grass were poor. The grass had a depressing effect on coconut yields, corrected by application of nitrogen.

Coconut plantation

Dwarf coconut palm

Size of nut and oil-content

Coconut oil is the principal economic product of the palm. The ultimate criterion of yield should therefore be oil production per acre. In practice the presentation of results on the basis of copra yields has to suffice. It is fortunate that a study of oil contents showed there to be little difference between copra samples from various districts of Ceylon or from palms subjected to different treatments.

Child and Nathanael found 52 samples of Ceylon estate copra to have an average of oil (dry basis) 68.3%, and there were no significant differences between samples from the W., N.W., E. and S. Provinces. Child and Salgado found that during the second year after application fertiliser treatments did not affect the contents of oil or nitrogen in the copra. The average oil content of 96 samples from the Ceylon factorial experiment was 69.3% and nitrogen 1.04% (dry weight). Of the 148 samples examined during these two studies, 105 fell in the range 68.1 to 70.0% oil content.

Previously Georgi had found for 62 samples of Malayan copra an average of oil (dry basis) 65.6%. Allowing for variations in drying methods it seems likely that there do exist intrinsic differences in oil content between nuts from different countries. In the present state of knowledge, however, it is not possible to relate these to such factors as genetic differences, climate or soil conditions.

For experimental work in an area of limited geographical and climatic range it is quite adequate to express yields in copra weights. A further simplification has been possible as a result of the work of Pieris, who showed that a very high correlation existed between the weight of husked nuts and the weight of copra therefrom. Pieris recommended that, for purposes of field experimentation, husked nuts from the unit under investigation be weighed one month after picking; 32% of this weight gives, to a sufficient approximation, the amount of copra the nuts would yield. In Ceylon this regression coefficient has been adopted with satisfactory results.

Similarly (in Ceylon) 20% of the husked nut weight gives a reasonable estimate of the weight of oil therefrom.

Whilst manuring has not been found significantly to affect oil content, it is otherwise with nut size, or more precisely with the weight of kernel, and so of copra per nut. Salgado showed that potash tends to increase kernel weight and nitrogen to diminish it. On poor soils a complete N.P.K. mixture improved kernel weight by as much as 10%.

Coconut products

The present article has been confined to agricultural research. In producing countries there has also been much work directed to the improvement of coconut products. In 1939 the Commonwealth of the Philippines set up a 'National Coconut Corporation' for the purpose of 'adjusting the coconut industry to a position independent of trade preferences in the United States.' The war interrupted the Corporation's work, but since 1946 the Philippine coconut industry has shown good recovery. In 1944 the Government of India set up a Central Coconut Committee 'undertaking, assisting or encouraging agricultural, industrial, technological and economic research' on the coconut palm and its products.

Most recently, in 1949, a strong Commission in Ceylon published a 123 page report with sweeping recommendations for fostering the island's coconut industry in all its branches, with largely increased provision for research.

The average yield of just over a million acres of coconut land in Ceylon is roughly 5 to 6 cwt. in terms of oil per acre, and the average in other countries cannot be much higher than this. Annual yields equivalent to half a ton of oil are readily obtainable on ordinary well-cared-for lands, and yields of three-quarters of a ton are not unknown. The above discussion on manuring referred to increments of yield obtained by suitable use of fertilisers of the order of 4 cwt. of copra (or, say, 3 cwt. of oil) per acre. It is possible to envisage in Ceylon alone an overall increase in annual output equivalent to 1 or 2 cwt. of oil per acre, or a total of at least 50,000 tons of oil, by the extension of manuring and good cultivation.

Conclusion

By the application in all coconut-producing countries of present technical information, it is certain that the world's fat supplies could be increased by 250,000 tons annually at a fraction of the cost of clearing land for the same production from annual crops. As Sir John Russell said in his Presidential Address to the British Association, 1949: 'Most countries could increase their food production considerably by applying known methods of improvement and raising the average performance to the level of the best.'

(From: Empire Journal of Experimental Agriculture, 1950, **xviii**, 71, *pp.* 177-189.)

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Erratum

In last month's Editorial Comment on the silver jubilee of the Imperial College of Tropical Agriculture we inadvertently described it as having been founded originally in 1921 as the West *African* Agricultural College; this should, of course, have read 'West *Indian* Agricultural College' and we apologise for any misunderstandings which may have occurred.

Mechanised Land Clearing

Massey Harris 744 D tractor operating with the Darlington winch. Weights have been fitted to the front wheels

IN recent issues of WORLD CROPS there have appeared articles dealing with mechanised land clearing.[1, 2] Recently some further information has come to hand in this connection which is of interest.

Tractor winches

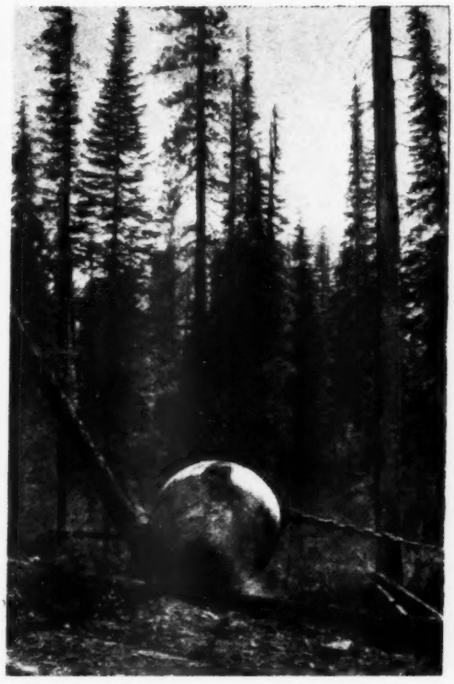
In Europe and the U.S.A. tractor winches have of late years become increasingly popular in connection with land clearance work, and a number of firms now manufacture these for attachment to various types of tractor. Machines of this type are now being used in the Niger Agricultural Project at Mokwa in Nigeria, which was commenced in May 1949 by the Colonial Development Corporation, the object being to open up a large tract of sparsely populated land to establish thereon peasant holdings on a share-cropping basis.

The area was recently visited by Messrs. A. H. Saville and H. C. Thorpe and the following brief account of the operations is based on Appendix XII of the Report[3] on their Sorghum Mission to certain British African territories.

In operation the winch is mounted on the tractor which is anchored in front, while the cable is attached to the tree to be extracted. Messrs. Saville and Thorpe reported that the tractor-powered winches were much quicker in operation than hand labour or hand-powered winches. They considered that they were a very promising method of removing trees up to at least 18 in. in diameter, at any rate on the sandy type of soil commonly encountered in the middle belt of Nigeria, and particularly when the ground was soft. They suggested that tractor winches might enable bush clearing to be carried out without resorting to bulldozing or chaindozing. They considered that some difficulty might be experienced in hauling uprooted trees away from the cultivation blocks and, in consequence, thought it might be necessary to substitute half-tracks on some of the wheeled tractors. A possible alternative might be to employ portable power-driven saws to cut up the trees, which can then be readily drawn away by wheeled tractors and trailers.

'Highballing'

Another development in a similar connection, devised in the U.S.A., is a process described in the U.S. journal *World Construction*[4] and our sister journal *The Muck shifter*,[5] termed 'highballing.' This is a variant on chaindozing as previously described in this journal. The method was invented to overcome the difficulty of keeping the cable off the ground when working by ordinary chaindozing methods, in as much as it tended to foul on tree stumps and irregularities. Steel balls, 8 ft. in diameter, were constructed and suspended in the centre of each clearing cable. This not only keeps the cable free but provides considerable leverage when trees are struck by the ball some 4 or 5 ft. above the ground. Through the centre of each ball there runs a 6-in. diameter steel shaft mounted on roller bearings, which are kept lubricated by oil within the ball while tractor and ball cables are



(*Left*) **View of tractor winch, controllable from driver's seat.** (*Right*) **An 8 ft. diam. steel 'highball', drawn on a cable between two tractors, fells a tree during clearance operations**

also jointed with swivels and jewels to prevent twisting and tangling.

Two methods of operation are possible. The first, for easier conditions, is to secure the ball and cable between the tractors and then proceed as in ordinary chain-dozing. Where, however, rapid work on heavy timber is involved, the procedure is to pay out from the tractors anything up to 900 ft. of cable, using special winches and leaving the ball stationary, while the tractors move forward on parallel paths several hundred feet apart. At a convenient point the tractors then halt and anchor their machines to trees. Working this way, it is stated, ball and cable can go through moderately heavy forests as fast as a man can walk, while the operators remain clear of the falling trees.

It is stated that this highballing method can deal with trees up to four ft. in diameter, and when working under varying conditions about 100 acres can be dealt with in an eight-hour shift.

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2. 'Mechanised Land Clearing in Tanganyika,' by McBride, Capell, Cathie, Kaufmann, and A. H. Bunting, WORLD CROPS, **3**, 89.
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Empire Cotton Growing History

From time to time we have published accounts of the excellent work of the Empire Cotton Growing Corporation which was incorporated by Royal Charter in 1921. During its 30 years of existence many distinguished plant breeders, pathologists, geneticists, and so on, have been employed by the E.C.G.C. and it is largely through their exertions that cotton production within the British Commonwealth has increased almost sixfold during the last 30 years.

Many requests are received by the Corporation for details of their work and a short history, which was published in the January issue of the *E.C.G.C. Review*, has now been published as a 44-page booklet entitled *Empire Cotton Growing Corporation*, 1921-50.

The booklet is available, free of charge, on application to the Secretary of the Corporation at 12 Chantrey House, Eccleston Street, London, S.W.1.

CORRESPONDENCE

Power and Peasant Holdings

TO THE EDITOR

Sir,

In his valuable letter, 'Mechanised Peasant Farming,' WORLD CROPS, April 1951, Mr. J. H. Ritchie doubts the economy of a light tractor in one paragraph and goes on to suggest another, a small tracklayer, which is, in this country at any rate, much the same in price. Apart from capital outlay, the crawler carries the burden of track maintenance additionally. However, it is not my purpose to decry any machine but to point out that the logic of his reasoning escapes me.

The problems of mechanisation on small farms in all lands are very real, but it is better to accept them as a challenge rather than as arguments to engender a spirit of hopelessness. It is because man is such a poor source of power that he should be put in charge of as big a unit of mechanical power as is consistent with physical and economic conditions.

As the proportion of human power is reduced in the task of food production, so do the chances of cost reduction increase. So, also, do the risks of famines diminish.

A well-fed and enlightened peasant is more likely to do something about the economic circumstances surrounding his holding than one who, living at subsistence level, toils incessantly bewailing the fact that his acreage is not large enough for mechanisation.

In short, you cannot overcome the economic handicaps of smallholdings by the use of power units that are too small for all the work and that do not raise the productivity of man as much as has been proved possible in many parts of the world. For example, Northern Ireland with 66% of her farms under 30 acres increased the tractor population on her 90,000 farms by 12,300 in ten years. In that period the value of Ulster farm produce was tripled and increased volume and yield played a greater part than rising prices.

Yours faithfully,

A. B. LEES

April 23, 1951

CORRESPONDENCE

The columns of WORLD CROPS are open to correspondence and the Editor welcomes letters from readers supplementing and commenting on articles or on other matters within our sphere. Limitations of space may necessitate the abridgement of letters.

New Ideas on Soil Fertility

Part II

D. P. HOPKINS, B.Sc., F.R.I.C.

This is the second part of Mr. Hopkins' article, the first of which appeared in last month's issue. In this instalment he discusses new ideas on the fixation of phosphates in the soil, some recent views on nitrogen transformations in the soil, emanating from India, and the role of molybdenum in plant nutrition.

THE second paper of 1950 which seems to the present writer to possess considerable significance is a study by P. H. Struthers and D. H. Sieling (of Massachusetts Agricultural Experiment Station) of the inhibiting effects of organic acid anions upon phosphate precipitation by iron and aluminium. Here again a natural process is involved and the role of organic matter in fertility maintenance emphasised. The fact that phosphate precipitation by these metallic ions is reduced if certain organic acid anions are also present had, in fact, been reported in a 1949 paper from the same research centre.

The evidence presented is purely chemical; the relationships between iron and/or aluminium and phosphate anions in the presence of various organic acid anions have been studied at various pH levels by normal laboratory methods, and the application of the results to soil processes is purely deductive.

As is well known, one of the major causes of phosphate wastage, particularly in acid soils, is the precipitation of soluble phosphate by its combination with iron or aluminium. The insoluble compounds thus formed are unavailable forms of phosphate; other precipitations (or 'reversions'), particularly that caused by calcium, produce phosphate complexes which still possess a useful degree of availability. Although many investigators have tried to elucidate the nature of the various complexes that soluble phosphate may form with soil ingredients, the general problem is still only superficially understood.

The Massachusetts work indicates that certain organic acid anions also form compounds or complexes with iron and aluminium, and once these have been formed, the iron and aluminium will not also precipitate phosphate. The extent to which this protective reaction takes place depends upon the type of organic acid—some are much more effective than others—and also upon the pH of the solution.

Acids investigated

Nine different organic acids were investigated; of these the most effective in reducing phosphate precipitation were: citric, oxalic, tartaric, malonic and malic acids. Citric acid was the most effective for both iron and aluminium, the others varied according to whether iron or aluminium precipitation of phosphate was studied. Moreover, the different acids exerted their maximum influence at different pH ranges. The citrate ion was outstanding since it exercised a powerful effect over fairly wide pH ranges—pH 4-9 for aluminium and pH 4-6 for iron.

The full significance of this work does not become apparent until it is linked with existing knowledge of organic acids (or their anions) found in soils. It seems more than a coincidence that the acids named occur in some quantity in soils as a consequence of bacterial decomposition of organic matter. Thus '*at any pH within the entire range of values for agricultural soils*' one or more of them can be expected to be '*markedly effective in preventing precipitation of phosphate by iron or aluminium.*' The authors of the paper go further and describe these organic anions as '*nature's effective agents for preventing phosphate fixation by iron and aluminium in neutral and acid soils and for making available phosphate which has already been fixed.*' They believe that other organic acids, or their salts formed in the decomposition of organic matter in soils, are likely to exercise similar inhibiting effects upon phosphate precipitation—particularly uronic acids and polyuronides which are also known to occur in considerable amounts.

Implications

Here again a new idea provides a more credible explanation of certain soil phenomena than do previous conceptions. The fact that organic matter helps to keep phosphate available in soils has been observed by several workers, and a number of attempts have been made to explain this, *e.g.* the formation of organic phosphates, the encouragement of phosphate-releasing bacteria, increase in the amount of carbon dioxide in soils to act as a phosphate-dissolving agent; nevertheless, there is little evidence that organic phosphates are formed in significant quantity, and the existence of phosphate-releasing bacterial processes seems to be wholly speculative; as for carbon dioxide, it seems too much to expect that additions to the quantities always present would have such marked effects upon phosphate availability, for water is fairly readily saturated with this gas. The idea that organic matter reduces phosphate fixation because of the production of organic acids and their anions is more satisfactory.

The failure of repeated applications of lime to release fixed phosphate is also explained; if an iron phosphate complex has been precipitated at a pH of 4.0, changing the pH to 6.0 by adding alkali will release only 7% of the phosphate which has been fixed. On the other hand, at the same pH of 4.0 the oxalate ion will release 43% of the 'iron-fixed' phosphate and the citrate ion will release 89%; while for 'aluminium-fixed' phosphate these two anions will respectively release 50 and 100%. Lime applications may, as the authors suggest, owe their phosphate-releasing effects not to pH changes directly but to their ability to encourage bacterial activity (an indirect effect of pH change), thereby encouraging the greater production of organic acid anions from the soil's organic matter. Unless enough organic matter is present, however, frequent liming can produce only small increases in phosphate availability.

Bearing on analytical methods

This work seems to have a considerable bearing upon methods of soil analysis for phosphates. The arbitrary selection of citric acid or citrate solutions as extractants is given a new setting. May not citrate anions, used in laboratory extractions of soil phosphate, release fixed phosphate in iron and aluminium combinations? In this event, unless the soil contains enough organic matter to provide corresponding

amounts of citrate or other effective anions during crop production, the figure obtained for available phosphate is likely to be misleading. The many anomalies of predictions based on soil analysis are well known, as are the arguments in favour of this or that extracting solution as a measure of ' truth,' and in the circumstances this new research seems very relevant.

It should not, of course, be supposed that the effect of organic acid anions in repressing phosphate fixation is a trace or catalytic effect; it is in fact chemically quantitative. It is true that some anions may have less effect than others, while the same anion may be more effective at one pH than another, but there is a definite chemical relationship between the quantity of the anion present and the maximum quantity of phosphate whose availability it can protect. There seems no hope, for example, that the application of a small amount of, say, citrate will release or protect a large amount of phosphate.

Practical implications

Nevertheless, the idea that ' artificial ' additions of citrates or other suitable organic acid salts to the soil could act as indirect fertilisers might be worth pursuing. Economically, the idea in its crude form is certainly not hopeful since citrates are more expensive than phosphates. But it might, on the other hand, be possible to prepare granulated soluble phosphates coated with a surface layer of citrate; placed band dressings and the use of granules have both shown that fixation losses are reduced by reducing the contact between the phosphate and the soil, and a skin of citrate (by dealing with the iron and aluminium in the surrounding soil solution) might increase the defences of the granule and the ' zone ' of availability that it sets up. Such a possibility is perhaps fanciful, but it seems at least worthy of preliminary investigation.

The general application in agriculture of the idea put forward in this work of course involves more than merely maintaining a generous supply of organic matter to the soil. The micro-organic processes by which the effective organic acids are produced in the soil require detailed study; it may be that means can be found to encourage these natural processes so that increased amounts of acids become available. Moreover, soils whose high-fixing power for phosphate has long been troublesome may respond particularly readily to organic matter treatment. In such cases the pre-mixing of phosphatic fertilisers with suitable organic materials followed by the placed applications of such mixtures may increase considerably the proportion of the phosphate dressing that can be taken up by an annual crop and thus reduce the amount of fertiliser required.

A Russian contribution

Incidentally a Russian paper by P. A. Dmitrenko, published in 1949, appears to give some support to this organic acid anion theory, though in fact the paper draws other conclusions. In this work the same quantity of nitrogen was applied to oats as ammonium chloride, ammonium oxalate, and ammonium citrate. Growth of the oats was increased by 118, 126, and 128% respectively at one rate of nitrogen application, but when this rate was doubled the ammonium chloride gave a growth reduction of 38%, but the oxalate increased growth by 171% and the citrate by 144%. The Russian interpretation was that the chloride anion has an adverse effect upon fertility because it is not bound by the soil. However, if the phosphate-activating influence of the citrate and oxalate anions is accepted, it is clear that the differential effects of these ammonium compounds are explicable through their indirect capacity to provide phosphate, to release it from the fixed reserve in soil or to prevent already available phosphate from being lost by fixation. This Russian work is interesting as there do not seem to be many reported results of the effects of citrates or oxalates upon plant yields.

New ideas from India

In both these 1950 papers the interdependence of organic matter and inorganic nutrient processes in soils has been demonstrated. By contrast some new conceptions of soil behaviour may be mentioned; these are contained in Dr. A. N. Puri's recent book entitled *Soils, Their Physics and Chemistry*, and comprise a major effort to simplify and unify soil science. This well-known Indian scientist looks upon all soils as acids; their essential framework is composed of hydrated ferro-alumino-silicates, the hydrogen in which provides the hydrogen ions required for the display of acid properties. Other matter in soils is extraneous; their fundamental physical and chemical properties are determined by their constitution as mixtures of ' acidoids ' (such insoluble acids as silicic acid) and ' saloids,' the insoluble salts of the acidoids. To Dr. Puri humus in soils seems important only so far as concerns that fraction which reacts with alkalis, and which is, in fact, an ' acidoid ' of the same type as a ferro-alumino-silicate.

It is not possible in a few sentences here to give a just picture of the nature and width of this new thesis. In his book Dr. Puri applies it to most of the chemical and physical problems of soils. One example of this thesis in action must serve. Puri contends that the process of nitrification is not conducted by micro-organisms. The mechanism of the nitrite →nitrate conversion is, in his view, purely chemical, thus:

H soil + KNO_2 → K soil + HNO_2.

Immediately the acid, HNO_2 (nitrous acid), is formed it is oxidised by oxygen in the air to nitric acid. $HNO_2 + O \rightarrow HNO_3$. The nitric acid thus produced reacts with further KNO_2, giving KNO_3 and more free HNO_2, which is again oxidised to provide more nitric acid. The nitric acid also reacts with the K soil and regenerates the original H soil or ' acidoid.' These processes continue until nearly all the nitrite supply has been converted into nitrate. In support of these suggestions Puri has shown that 0.2 gm. of potassium nitrite can be completely converted in the dark to potassium nitrate in 13 hours by 5 gm. of soil, even when the reaction is carried out with the soil held in chloroform and sterilised by heating under pressure in an autoclave. He concludes that ' *these results leave no doubt that biological and photochemical factors play no part whatsoever in the oxidation of nitrites to nitrates in soils.*' The rate of nitrification is decided by the quantity of acidoid in the soil mixture of acidoids and saloids.

It is very doubtful whether the Puri theory of soil behaviour has universal application; it will certainly not gain universal acceptance. It may, however, be of great value in dealing with the problems of acid soils of low organic status, soils which are in fact natural acidoids and saloids already largely freed from the extraneous matter which Puri dismisses as being of little account.

Molybdenum as a plant nutrient

The presence of molybdenum in plant material was first recognised in 1900 by a French scientist, Demarcay. For those who like semi-centenary reflections it will seem particularly appropriate that a new climax of interest in this trace element should have been reached in 1950. All the emphasis of recent work has been laid upon the relationships between molybdenum and nitrogen assimilation, a direction of study that was started in the 'thirties when it was found that molybdenum was essential, or at any rate beneficial, for the nitrogen-fixing azotobacter. Later work appeared to widen this observation, traces of molybdenum being also found beneficial for the nitrogen-fixing bacteria associated with legumes.

However, it is only quite recently that molybdenum has been admitted to the ranks of essential elements for plant-growth. Plants' requirements of molybdenum, as shown by the amounts actually assimilated, are more tracelike than any of the previously recognised trace elements, a fact that has required exceptionally refined methods of purification in solution or sand culture investigation and new techniques of analysis to determine the amounts of molybdenum in growing plants.

Dual functions

In striving to follow progress with this trace element, it is wise to distinguish between the functions of molybdenum as a nutrient for nitrogen-fixing bacteria and its functions as a constituent of plants themselves. Confusion is only too easy for the functions in plants are also associated with nitrogen 'handling.' Hewitt and Jones of Long Ashton (England), in what was probably the first work clearly to demonstrate that molybdenum was an essential plant nutrient (1947), showed that the visual molybdenum deficiencies produced in sand culture (for tomatoes, cauliflower, cabbage and mustard) were associated with excessive concentrations of nitrate-N in plant leaves. Molybdenum is necessary if nitrates absorbed by plants are to be synthesised efficiently into proteins and other nitrogenous compounds required in plant development. Other work indicates that less molybdenum is needed when plants are fed upon ammonium forms of nitrogen; in normal cultivation of crops, however, it may be assumed that ammonium nitrogen is mainly pre-converted into the nitrate form.

Molybdenum deficiencies

To what extent are molybdenum deficiencies in soils likely to be encountered? Or, put in another and perhaps more practical way, to what extent have maximum yields of crops not been reached in the past because of limitations upon the soil's supply of molybdenum? Investigations in these directions are only just beginning. American plot tests with alfalfa (or lucerne) in 1949 showed that sodium molybdate at the low rate of 1 lb. per acre increased yields by 12% and the nitrogen contents of the crops by 4%. In Australia, however, practice has advanced well beyond the stage of plot-test probing. The geological age of so much of Australia's soil has led to severe trace element deficiency, leaching being probably the major cause. In the drier regions, however, the nitrogen supply must be maintained by clover's leguminous fixation bacteria, fertilisers such as sulphate of ammonia having proved ineffective owing to the lack of soil moisture. For subterranean clover growth, sodium molybdate and molybdenum trioxide have been found essential and they are widely used as soil additions. They are also necessary for the oat crop when grown in these dry regions. The majority of practical responses to molybdenum applications, however, are associated with acid soils and legume crops. This generalisation fits our present state of knowledge with satisfactory neatness. Legume crops seem to require molybdenum (*a*) for the bacteria, and (*b*) for the plant processes by which assimilated nitrate is synthesised into proteins, etc. It is also known that molybdenum availability in soils is reduced by acid conditions. The total demand of the leguminous crop may often be greater than the amount of molybdenum an acid soil can supply.

Toxicity of molybdenum

A difficult complication is the fact that molybdenum is toxic to cattle if excessively present in pasture vegetation; indeed, earlier studies seemed to class it as a dangerous rather than an essential element. Remedial dressings must in consequence be very low. For example, 2 oz. of molybdenum trioxide per acre is the usual application on Australian pastures; while 4 oz. per acre is a recent American recommendation.

Conclusion

Certainly there is no shortage of new and stimulating ideas at the middle turn of the 20th century. If their validity is indeed fundamental, further investigations at different centres will confirm their value as re-directing influences in the advance of soil science and knowledge of soil fertility.

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Initial Year of Prairie Regional Laboratory

Established a little more than a year ago, the NRC Prairie Regional Laboratory at Saskatoon is now in full operation. It is engaged in studying at first hand the problems of finding industrial uses for farm wastes, and otherwise bringing the results of scientific research to the aid of the western farmer.

Fermentation of sugars is being studied and the corn smut fungus has been found to be useful in producing antibiotics, fats and sterols. Several antibiotics produced by bacteria are being tested for the control of plant pathogens causing loose smut of barley and wheat.

Nearly 1,200 bacterial organisms were investigated last year and it was found that almost half of them gave satisfactory fermentations with glucose for the production of 2,3-butanediol (used as antifreeze), ethanol (ethyl alcohol), acetone, and lactic acid. Several new analytical procedures were also developed.

Studies on the production of glycerol with *Bacillus subtilis* (the Ford type) were continued, with the immediate object of finding the best conditions for the rapid fermentation of starch material to glycerol. A thorough understanding of the nutrition and metabolism of micro-organisms will not only aid in development and control of industrial processes, but the knowledge obtained from these studies may be applied to higher organisms, with consequent benefit to medicine and agriculture.

Fundamental research is shedding some light on the formation of lignin in wheat plants. It has been found that young wheat seedlings contain only a fraction of 1% lignin, but that the percentage increases rapidly as the plant heads out. Isotopes from Chalk River are being used as tracers in this study.

New results have been obtained on the composition of rapeseed oil which show higher values for eicosenoic and linolenic acids and a lower value for erucic acid than had been previously reported by other workers.

Production of experimental straw board was begun during the year and 400 test boards have been made to date. Tests on these boards show that they compare favourably with standard commercial fibre boards.

About 60 persons are employed in the Prairie Regional Laboratory, of which Dr. G. A. Ledingham is the director.

FARM MACHINERY

Sprayer Developments

The opening of a new factory at Maidstone, Kent, mentioned in last month's WORLD CROPS marks an important step forward in the history of Drake and Fletcher Ltd., whose spraying, dusting and grading machines are exported to over 40 countries outside the U.K. The new building houses the whole of the firm's production, and the tractor and implement repair workshops—an improvement which will enable a far greater volume of work to be handled.

Their well-known L.O. Estate Sprayer is now being manufactured in four models, all of which are described as being capable of carrying out every spraying job likely to be required on estates, smallholdings, orchards and small farms; for instance, hand spraying in orchards, automatic spraying of cordon fruit and crop spraying with weedkillers, fungicides, insecticides, hormones, etc.

The four models include a self-powered hand-draught machine, mounted on three wheels, a self-powered tractor draught machine on two wheels with tractor drawbar, a self-powered garden tractor model on three wheels and having a special drawbar with foot rest and seat to make the whole a compact unit with the garden tractor, and a tractor power take-off model on two wheels with a p.t.o. shaft.

An additional feature of these machines is the automatic filling of the tank through a strainer suction unit. This unit, provided with a length of suction hose, is fixed into the tank when spraying is in progress; it is removed and inserted into a stream, mixing tank or other source of supply for filling purposes.

Advance particulars have now been released concerning the new 'Minicrop' sprayer for applications ranging from 5 to 500 gal./acre. Preliminary specifications describe this sprayer as having a pump with output of 700 gal./hour, pressure up to 60 lb./sq. in., driven from the tractor power take-off; the tank has a 60-gal. capacity; the spray boom is 20 ft. wide with adjustable height from 18 in. to 30 in.; length is 7 ft. 6 in., height 4 ft., width 7 ft. 1 in., and nett weight 3½ cwt.

Production of 'Mystifier' sprayers at Messrs. Drake and Fletcher's new premises

Four models of the L.O. estate sprayer. (*Top left*) **Automatic spraying in cordon fruit.** (*Top right*) **Self-powered tractor draught machine on two wheels.** (*Bottom left*) **Hand draught machine (strainer suction unit in action).** (*Bottom right*) **Operating with crop-spraying boom**

Lysander Crop Spraying Team

Four Westland Lysander aircraft, powered by 'Bristol' Perseus engines, are being used in Canada for extensive crop-spraying work. The Perseus was the first 'Bristol' sleeve-valve engine and was run for the first time in 1932.

The September issue of *Canadian Aviation* reveals that a small Canadian company has been operating four war-surplus Lysanders since 1946. The aircraft, fitted with spray-booms beneath the mainplanes, fly at 140 m.p.h. at a height of 8 ft. With one load of liquid they can cover 300 acres in 30 min. The swathe from the aircraft is 120 ft. wide, and any field of from 100 acres upwards is said to be suitable for spraying.

The Lysanders work across Canada from the west coast, spraying farms to the orders of an agent ahead. The aircraft, accompanied by a team with truck, car and caravan, work from the farms on which spraying is to be carried out.

Materials Shortage Affects Machinery Output

International Harvester Company of Chicago recently announced stiff cuts in production of three models of tractors and 16 major farm implements because of the shortage of materials. The company said the cuts would be effective in April and May production, and would be reflected in shipments during May and June.

The numbers of machines cut from shipping schedules for May and June are:

Farmall Cub tractors	2,700
'6' Series crawler tractors	400
Farmall Harvester tractors	650
Ensilage blowers	860
Row-crop cultivators	5,100
Disk harrows	8,400
Peg harrow sections	19,220
Harvester-threshers	1,150
Listers and busters	2,175
Power loaders	1,290
Mowers	14,530
Corn pickers	600
Planters	3,200
Disk ploughs	2,000
Harrow ploughs	850
Mouldboard ploughs	7,225
Hay rakes	7,250
Manure spreaders	1,250
All-purpose farm trucks	3,200

In relating this announcement of a production setback to export shipments, the firm's foreign operations department pointed out that International Harvester will continue to divide production equitably between demand in the United States and that originating abroad.

Massey Harris' Irish Exhibits

The new 701 one-man pick-up baler and the recently introduced 716 Dickie tractor rake were both among the Massey Harris machines which were exhibited for the first time in Ireland at the Royal Dublin Society's Spring Show and Industries Fair, held May 1-5, and the Royal Ulster Agricultural Society's Show, held May 23-26. Altogether 12 machines were exhibited at both shows.

Loyd 'Dragon' Exports

Overseas sales of the Loyd 'Dragon' tractor are reported to be increasing and altogether 20 countries are now importing 'Dragons,' mostly resulting from successful trials of sample models sent to test the market.

A £60,000 order for 40 tractors has been received from Brazil and another order worth around £80,000 has come from Turkey. Vivian Loyd and Co. have lately appointed distributors for Egypt, Turkey, Portugal and Venezuela.

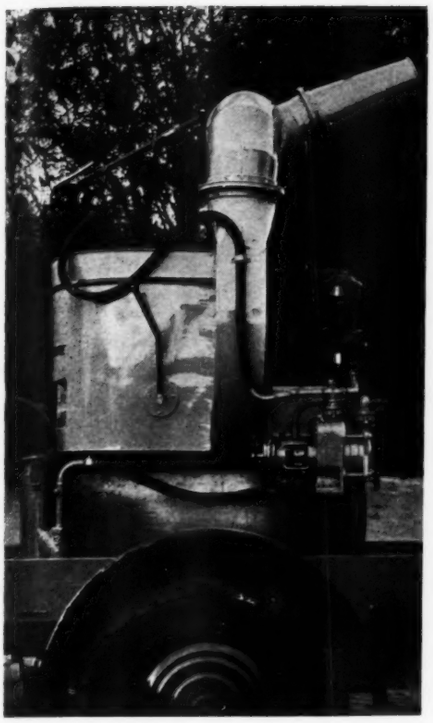
The new revised home sales price of the 'Dragon' tractor is £1,595 ex-works, having been increased from £1,450.

Latest additions to the range of mounted implements for the Fordson Major tractor are shown above. The two-row potato planting attachment consists of frame, hoppers, seats, opening ploughs and timing device; it can be attached to the mounted ridger. The top picture shows a root puller attached to the hydraulic lift. The method used for the removal of stumps is to attack the main roots with the adjustable knife from three sides. The Puller is then stuck into the stump from the fourth side and roots and stumps are pulled out bodily

Combined Dusting and Spraying

A demonstration was recently given near London of the range of 'Whirlwind' dusters and spraying machines, by Messrs. Universal Crop Protection. The 'Whirlwind' duster, the combination duster-sprayer and the prototype of a new machine —the 'Whirlwind' junior—were all shown at work, enabling those who had ordered similar machines to be sent abroad to see their performances for themselves.

The 'Whirlwind' is at present manufactured in Holland, and it will soon be made in England as well. Readers may remember our description (WORLD CROPS, **2**, 11, p. 485, Nov. 1950) of the work



The ' Whirlwind ' combination duster/sprayer, manufactured by Universal Crop Protection, Ltd.

The ' Nodrif ' cowled spray boom fitted to a ' Cambridge ' standard spraying machine. One section of the cowling is raised to show nozzles on spraybar. The tractor is fitted with the latest Mark II gas-proof cab

carried out by Dr. Dike in Ceylon with dust blowing machines for spreading fungicides on tea bushes infected with Blister Blight. It was mainly in that country that the ' Whirlwind ' was developed. The machine consists essentially of a hopper, engine, generator and main outlet; air is sucked through the bottom of the hopper, through the generator and out through the trunklike main outlet. The opening of a valve enables dust to fall into the air-stream, which is blown out at approximately 100 m.p.h., giving an effective dusting range of 200 ft. under good conditions. The dusting rate can be regulated from 0-35 lb./min. and the outlet trunk can be rotated by a direction lever.

The combined spraying and dusting machine has a pump added to the ' Whirlwind.' The dusting system is the same, only there is a secondary drive to the pump which can be clutched in. The spray tank has a capacity of 23 gallons and continuous agitation of the liquid is achieved by a return flow from the pump. Spray pressure is controlled by an adjustable valve, excess liquid being returned to the tank by the return flow pipe. The nozzle at the end of the main outlet diffuses the liquid in the air stream where it becomes further atomised. For spraying selective weed-killers and other toxic chemicals, the ' Whirlwind ' can be modified to work with a boom sprayer at rates varying from 5-30 gal./acre.

Elimination of Spray Drift

The problem of wind drift of agricultural chemicals has reduced the number of spraying days, in Britain at any rate, on which the farmer can attack crop pests. Besides the economic disadvantage of loss of spray chemical there are dangers of spray drift causing damage to adjoining susceptible crops and toxic hazards to operators and even passers-by.

Pest Control Ltd., pioneers of several safety measures used in crop spraying, have now developed a cowling attachment on a 500-gal trailer with 40-ft. spray-bar width, which almost completely eliminates spray drift, thus enabling operations to continue under windy conditions when normally the machine would be lying idle.

Dr. W. E. Ripper, managing director of the firm, has been experimenting for over 11 years with devices for overcoming the effect of wind on sprays; early this year the first successful prototype was produced. Called the ' Nodrif,' it consists of a cover which encloses the area of ground to be sprayed at any moment in such a way that the wind is largely prevented from affecting the spray even when finely divided.

The spraybar cowling is in three sections and is fitted to the spray booms. The side booms are fitted with castor wheels to maintain a constant distance from the ground. The cowling or wind shields form an obtuse angle with the field surface and wind resistance is thus reduced by deflection over the shield.

Side winds are guarded against by folding triangular deflectors, and a fringed rubber curtain along the lower edge of each section of cowling helps further to prevent wind from getting under the shield.

Extent of wind drift depends on four factors: (1) Height of spraybar above ground, (2) velocity of wind, (3) size of droplet, (4) pressure at nozzle.

Generally speaking, the higher the pressure the finer the droplets, but practical trials have proved that with pressures between 30 and 65 lb./sq. in. and with wind up to 13 m.p.h., the saving in drift is remarkable. As a result of wind tests, figures show that about 53-100% of the spray drift can be prevented by the ' Nodrif ' boom, and that with a wind velocity above 12 m.p.h. 18-28% of the spray is blown away when an ordinary spray boom is used.

Now that the main difficulties have been overcome in principle of design, there is a clear field for adaption of the ' Nodrif ' to other types of spraying machines, from the small handy farmer's Weedmaster to the mammoth contract machines. The attachment, on a 500-gal. trailer (see photograph), was recently demonstrated at Bourn airfield, headquarters of Pest Control.

Also shown was an improved gas-proof air-conditioned tractor cab. New features include temperature control and a device whereby the tractor cannot be moved unless the cab door is closed. The cab is almost airtight and air is pressed through a compressor driven from the tractor's power take-off. On the intake side of the compressor is a large charcoal filter which absorbs gases, and in front of this is a

filter which collects fine smoke and dusts. A pressure, somewhat higher than atmospheric, is maintained, and air escapes out of gaps in the cab through which the tractor controls pass.

Temperature control is effected by heat insulation and the trickling of water over the cab. As the spraying machine has to be frequently refilled with water, it is a simple matter to refill the tank on the air-conditioned cab at the same time. Inside the cab is a thermometer, and a tap which the operator turns on as soon as the thermometer shows a temperature above 70°F. This tap sets the additional cooling device into action.

Better Mechanisation in Belgian Congo

In the development of vast areas of the Belgian Congo, correct use and maintenance of roadbuilding, earthmoving and logging machinery has become increasingly important. As a result of this a greater emphasis by trading firms in that country has been made on the training of sales and service officials so that they may be competent to look after equipment and maintain adequate service facilities.

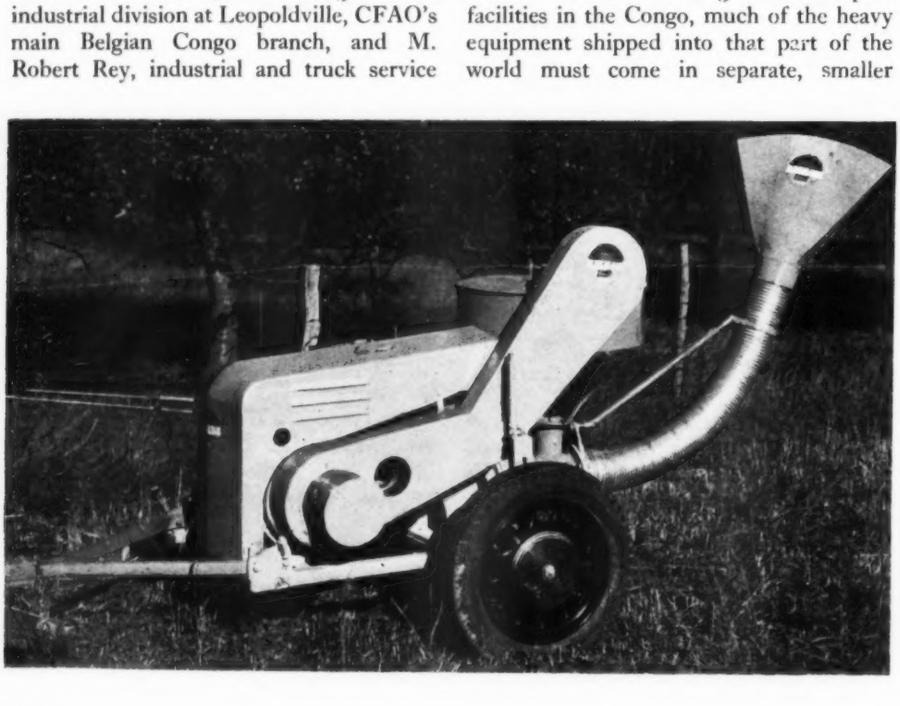
One organisation, Cie. Francaise de l'Afrique Occidentale, distributor of International Harvester products in the Belgian Congo and other French African colonies, sends men to the United States for both practical and theoretical work in special fields.

A current example of the degree to which this co-ordination can be carried on is the two and a half month visit to America of M. Peter Dubois, sales manager of the industrial division at Leopoldville, CFAO's main Belgian Congo branch, and M. Robert Rey, industrial and truck service manager at Stanleyville. During their visit they inspected and studied in International Harvester factories, sales and service operations, proving grounds and with industrial distributors, and in plants of firms manufacturing allied equipment. At each location schedules were arranged for close study of machines and conditions similar to those used and found in the Congo.

The CFAO officials paid close attention to disassembly of the machines they work with and subsequent reassembly. Due to lack of modern landing and transport facilities in the Congo, much of the heavy equipment shipped into that part of the world must come in separate, smaller units; then it is set up and put into operation on the spot where the work is to be done.

Having returned to their remote parts of Africa, these men can now inform other CFAO personnel and hundreds of native workers how trucks, tractors and farm machinery should best be operated. Along the far reaches of the Congo River they will be able to advise on methods for clearing and preparing land where cotton, cane and rice can be raised with modern farm machinery.

The new Loyd 'Dragon' crawler tractor which incorporates clutch brake steering



The Allman 'Klingkloud' turbine-operated crop duster and portable power unit

WORLD CROPS

OUR NEXT ISSUE will include an article on **the cultivation of tung trees and production of tung oil,** by G. T. Bray, F.R.I.C., of the Colonial Products Advisory Bureau. H. H. Nicholson, M.B.E., M.A., of the Department of Agriculture, Cambridge University, has contributed an article on **the control of ground water in reclaimed marshland** and this will also appear in July. Also included will be the last part of Colin Maher's article on **soil conservation development in Kenya.** Besides these, other articles will appear and the usual regular features.

WORLD CROP REPORTS

AUSTRALIA

1951 wheat disposition. A semi-official estimate of the disposition of Australia's current wheat crop, as reported by our Australian correspondent, shows that of a total crop of 187,500,000 bushels, 17,600,000 bushels will be retained for feed and seed. Of the marketable crop of 169,900,000 bushels, 61,300,000 bushels will be used in home consumption, leaving 108,600,000 bushels available for export. Of this quantity, it is estimated that 76,100,000 bushels will leave Australia in the form of grains and 32,500,000 bushels in the form of flour. Of the 61,300,000 bushels retained for home consumption, 36,000,000 bushels will become flour, 2,100,000 bushels will be consumed as breakfast foods, and 23,200,000 bushels will become stock feed.

ITALY

Satisfactory 1950 sugar-beet year. From our Italian correspondent we hear that the definite statistics now available show that in 1950 173,000 hectares in all were occupied under sugar beet in Italy. In all 4,380,000 tons of sugar beet were delivered to sugar factories, making an average of 25.3 tons/hectare.

The total area under sugar beet was 42,000 hectares, or 24%, larger than in 1949. This increase was not uniform throughout Italy. The provinces of Udine, Verona, Cremona, Parma and Modena, for instance, registered an increase of 50%, while Venice and Padua reported 40%, Mantua and Bologna 30%, Alessandria, Ravenna and Ferrara 20%, and Forli only 10%.

It appears that at present Italian farmers are feeling friendly towards this important but sometimes upsetting crop. The principal reason for this is, probably, the assistance which sugar factories are giving to all farmers growing sugar beet.

A special commission for the promotion of beet cultivation has now been engaged for over four years in careful study of all problems connected with this plant as well as in passing all information gleaned on to farmers. Treatment of seeds with gammexane has been found most efficacious in protecting the tender sprouts from various insects, especially *Elateridae*, and the use of granular fertilisers dropped into the soil together with seeds (apart from the general fertilising of the field) has been found to speed greatly the delicate initial stage of the plant's growth.

PARAGUAY

Slight cotton decline. A preliminary estimate by the trade has placed the production of cotton in Paraguay in 1950-51 at around 62,000 bales (of 500 lb. gross). This is about 6% below the 66,000-bale production of the previous season. Similarly, acreage planted has decreased by 6% from 161,000 acres in 1949-50 to 151,000 acres during the current season.

Climatic conditions have been favourable to the growth and development of the crop, although there was unusually heavy rainfall prior to the start of picking early in March. The Government of Paraguay is attempting to improve yields by wider distribution of better varieties. All of the seed from one of the better varieties grown in the country this season will be purchased by the Government for distribution to farmers. In addition, plans have been drawn for the distribution of 1,000,000 kgm. of pure seed annually in the regions of the country best suited to cotton. It is expected that the entire crop will be of a single variety in four years.

FRANCE

500 lb. of cotton seed sown. Our Paris correspondent reports that France is to grow cotton; experiments have been carried on in secret for some time. Overproduction of wine has caused this switch in the Languedoc (Southern France). Experiments have been carried out round Narbonne, in the Aude, near Bezier, and in other spots in the Herault Department. M. Billard, president of the Grain Merchants' Syndicate, has directed operations, and 100 growers have sown about three hectares each with cotton.

M. Billard first had the idea of growing cotton after reading a technical treatise on the heating of soil. He decided that crops grown in hot climates depended primarily on the soil, and that if the ground is silicous clay the culture of cotton in the Languedoc would be possible. An examination of the soil was undertaken and at the same time various types of cotton, particularly that grown in the United States, were examined.

Exactly three years ago the first experiment was undertaken. Four different types of cotton seed were sown on ground where rice had been cultivated previously. They flourished and reached from 30 to 35 centimetres when the dyke of a nearby rice plantation broke and the 500 cotton plants were destroyed.

The experiment was restarted. Import licences for seed were slow and then only one variety was permitted. In February 1950 the seeds were sown but violent rainfall threatened a poor crop, so all the plants which had germinated were torn out of the ground which was reploughed. The seed was resown in April.

The results were encouraging; 600 lb. of cotton were gathered. The raw cotton was sent to Tourcoing for spinning, weaving and testing as it was thought unwise to start the winegrowers cultivating cotton unless the quality was known to be satisfactory. The tests produced excellent results and cultivation has now started on a large scale; 500 lb. of cotton seed have been sown. The result is eagerly awaited.

INDIA

Jute and cotton hopes for 1951. India's cotton and jute industries, which had a black year in 1950, are expected to pick up this year with the inflow of raw cotton and jute from Pakistan. This is one of the most important results of the India-Pakistan trade agreement recently concluded at Karachi.

Official statistics regarding the leading national industries showed that the premier industry—cotton textiles—last year reached its lowest ebb since the partition of India three and a half years ago. The industry's output in 1950 was 3,667,000,000 yards of cloth, a decline of 237,000,000 yards compared with the previous year's production.

The statistics disclosed that the jute industry, India's major dollar-earner, had also touched a low ebb in 1950, with production totalling 836,000 tons, as against 946,000 tons in 1949, of jute goods.

Textile interests attributed the decline in cloth production to two factors—shortage of cotton, which led to the closure of several mills; strikes and absenteeism, especially the two-month Bombay textile strike last year resulting in the loss of 203,000,000 yards of cloth.

The cotton shortage was mainly due to the trade deadlock between India and Pakistan over Pakistan's decision not to devalue her currency after the sterling devaluation in September 1949. The deadlock was broken by a limited barter agreement between the two countries in October 1950, and the situation has been improved with the conclusion of a trade agreement in February this year.

India's jute industry, mainly concentrated in the Calcutta area, was handicapped by the shortage of raw jute which has come, for the most part, from the East Bengal province of Pakistan. Jute had been scarce in India since the partition

of the sub-continent in 1947, when nearly 75% of the jute-growing areas went to Pakistan. The position was aggravated by the Indo-Pakistan trade deadlock which followed the devaluation dispute, and Indian jute mills were restricted to working 42½ hours a week, instead of 48 hours as previously.

Tobacco industry's expansion. The annual export of Virginia and other tobaccos from India is estimated at 80,000,000 lb., mostly to the U.K. During 1950, out of a total export from Madras of 72,300,000 lb., valued at £7,300,000, 45,600,000 lb. were to the U.K.

Madras and Bombay States produce nearly 76% of the country's total production of 540,000,000 lb. Home consumption accounts for about 465,000,000 lb., but India is third among the tobacco-producing countries of the world. The United States is first and China second.

Production this year in the State of Madras is estimated at 270,918,710 lb., including 83,290,921 lb. of Virginia in an acreage of 355,641. Transplanting has already commenced in several districts to bring more acreage under cultivation next year.

Cotton exports to U.S.A. The U.S. has so far taken 19,000 of the 25,000 bales of Bengal Deshi Indian short staple cotton allotted at the end of last year. An additional 65,000 bales of the variety have been allocated for export to the U.S. this year, and export licences in respect of 47,000 bales have already been issued.

Other export quotas for Deshi this year included 52,000 bales for Japan, 20,000 bales for the United Kingdom, and 13,000 bales for soft currency countries.

SOUTH AFRICA

Optimistic maize forecast. Despite drought in some areas, this season's maize crop is reported as being ample for the Union, according to the manager of the Maize Industry Control Board. Johannesburg grain distributors report that recent favourable weather has brought about an improvement in the condition of the crop; this is likely to result in the final official figures being several million bags above the first Government estimate of 26,300,000 bags.

Expanding pineapple industry. There have been plenty of pineapples from bumper crops in the Cape Eastern Province, reports our correspondent. Canners were unable to absorb all this quantity and plans to develop a pineapple industry in the south-western Cape are now under way. Experimental crops grown in the Heidelberg, Cape, district have proved to be of good quality and this district has several big canning factories. Some canners believe that South Africa will be the biggest pineapple-canning country in the world within a few years.

Bad year for onion farmers. Because Holland has had a bumper crop and Egypt is supplying Britain with all the onions she wants at low prices, South African farmers are having a hard time selling their onion crops. Small quantities are being exported to Trinidad and the East, but it seems that there is no market for the bulk of the crop. About the lowest price farmers can ask in order to make a living is 15s. a bag, and the present price on the open market varies from 8s. to 10s.

Last year most of South Africa's surplus crop was sold to Britain at good prices, because the onion crop in Holland had failed.

SOUTHERN RHODESIA

Drought hits tobacco crop. Near-drought conditions, which have prevailed since the end of January in the colony, are expected to cause heavy losses to what was expected to be a record 130,000,000 lb. crop when planting began during the encouraging rains late last year. Several farmers in the Salisbury area have already written off whole crops.

EGYPT

Crops—1950. A summary of agricultural conditions in Egypt during 1950 has been given in the latest *Journal of the Anglo-Egyptian Chamber of Commerce*. One feddan equals 1.038 acres:

Cotton. Except in the north of the Delta, restrictions limiting the cotton acreage were lifted and the acreage for 1949-50 was 1,974,559 feddans, compared with 1,692,004 feddans the previous year. In spite of this, the estimated yield was 8,220,000 kantars (1 kantar=99.05 lb.), compared with 8,517,207 kantars in 1949. This drop in yield from 5.03 kantars/feddan to 4.16 kantars/feddan was caused by unfavourable weather in mid-summer.

Wheat. An acreage of 1,371,997 feddans yielded a crop of 6,785,000 ardebs (one ardeb of wheat=150 kg.), compared with 1,417,160 feddans yielding 7,782,000 ardebs in 1949.

Barley. Acreage in 1950 was 116,691 feddans, compared with 168,310 feddans in 1949. Average yields were 6.49 and 6.84 ardebs/feddan respectively (one ardeb of barley=120 kg.).

Beans. Acreage in 1950, 355,506 feddans, and in 1949 424,013 feddans; average yields 3.59 and 4.88 ardebs/feddan respectively (one ardeb of beans=155 kg.).

Maize and sorghum. These crops have on the whole given good results. Combined acreage in 1950 was 1,844,383 feddans, compared with 1,992,321 feddans the previous year. Yield per feddan of maize increased from 5.99 to 6.33 ardebs (one ardeb of maize=140 kg.).

Sugar cane. Acreage in 1950, 80,587 feddans, in 1949 85,494 feddans. But the acreage reserved for the sugar industry remained much the same; in 1950 this acreage was 74,199 feddans, and in 1949 73,432 feddans. Average yield in 1950 was 555 kantars/feddan, and in 1949 563 kantars/feddan. The hard winter and unusual frosts hindered the formation of sugar in the plant, so that the sugar content was the lowest known for a long time. Total production of sugar in 1950 was 174,407 tons, in 1949 190,800 tons, and in 1948 220,000 tons.

Onions. Acreage in 1950, 31,956 feddans, in 1949 35,677 feddans; average yield in 1950 126 kantars/feddan, in 1949 163 kantars, and in 1948 152 kantars. Some exporters have complained of the quality of the crop and difficulties of transport. Egyptian onions meet competition from South Africa and South America.

Fruit. During the last 10 years the acreage under fruit has greatly increased. In 1939 it was 54,000 feddans, in 1949 84,000 feddans. This increase has occurred mainly in vines, bananas, mangoes and olives.

In 1950 the banana crop was partly destroyed in the cold weather and prices were very high. Vines are now grown on 18,500 feddans, compared with 6,900 feddans in 1939, and yielded a good crop. The orange crop was satisfactory and brought in a higher revenue than last year. The Government agricultural services and some growers are taking an increasing interest in nursery gardening and the propagation of good varieties of fruit trees. The traditional cultivation of the date is still important and covers an acreage, including the oases, of nearly 7,500 feddans.

ENGLAND AND WALES

More flowers: less vegetables. The results of the January 1951 census of crops under glass in England and Wales have now been released by the Ministry of Agriculture. Compared with January 1950, the acreage of lettuce declined by 13% and tomato and cucumber seedlings by 12%, but flower and foliage crops increased by 40%.

The total area returned as being under glass (glasshouses and frames) was 5,118 acres in January this year, compared with 4,841 acres at the same time last year.